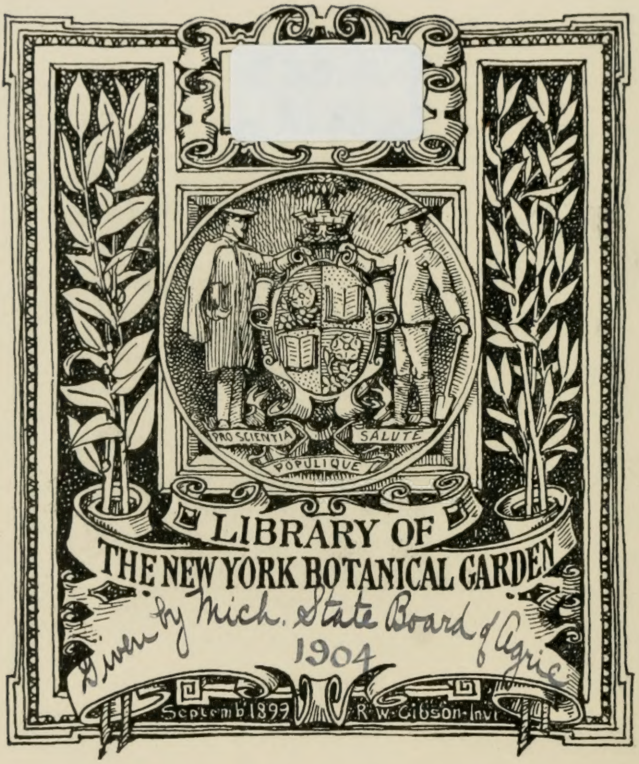

LIBRARY OF
THE NEW YORK BOTANICAL GARDEN

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1904

FORTIETH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE

OF THE

STATE OF MICHIGAN

AND

FOURTEENTH ANNUAL REPORT

OF THE

EXPERIMENT STATION

FROM

JULY 1, 1900, TO JUNE 30, 1901

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REPORT OF THE SECRETARY

OF THE

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GARDEN

STATE BOARD OF AGRICULTURE

Agricultural College,
July 1, 1901.

To Honorable Aaron T. Bliss,
Governor of the State of Michigan:

Sir—I have the honor to submit to you herewith, as required by statute, the accompanying report for the fiscal year ending June 30, 1901, with supplementary papers.

Very respectfully,
ARTHUR C. BIRD,
Secretary of the State Board of Agriculture.

STATE BOARD OF AGRICULTURE.

	Term expires.
THOMAS F. MARSTON, Bay City, President of the Board.	1903
EDWARD P. ALLEN, Ypsilanti,	1903
HOLLISTER F. MARSH, Allegan,	1905
L. WHITNEY WATKINS, Manchester,	1905
FRANKLIN WELLS, Constantine,	1907
CHAS. J. MONROE, South Haven,	1907
AARON T. BLISS, GOVERNOR OF THE STATE,	*Ex-Officio.*
JONATHAN L. SNYDER, PRES. OF COLLEGE,	

A. C. BIRD, AGRICULTURAL COLLEGE, SECRETARY.
B. F. DAVIS, LANSING, TREASURER.

STANDING COMMITTEES.

The President of the Board is *ex-officio* a member of each of the Standing Committees.

FINANCE,	H. F. Marsh, C. J. Monroe.
FARM MANAGEMENT,	Franklin Wells, L. W. Watkins.
BOTANY AND HORTICULTURE,	C. J. Monroe, L. W. Watkins.
BUILDINGS AND PROPERTY,	H. F. Marsh, Franklin Wells.
EMPLOYES,	L. W. Watkins, H. F. Marsh, J. L. Snyder.
FARMERS' INSTITUTES,	E. P. Allen, C. J. Monroe.
MECHANICAL DEPARTMENT,	H. F. Marsh, C. J. Monroe.
MILITARY AND ATHLETICS,	L. W. Watkins, H. F. Marsh.
COLLEGE LAND GRANT,	E. P. Allen, Franklin Wells.
STATE WEATHER SERVICE,	C. J. Monroe, H. F. Marsh.
EXPERIMENT STATION,	L. W. Watkins, C. J. Monroe.
LIBRARY,	Franklin Wells, E. P. Allen.
WOMEN'S DEPARTMENT,	E. P. Allen, C. J. Monroe.
CHEMICAL AND OTHER ACADEMIC DEPARTMENTS NOT OTHERWISE PROVIDED FOR,	Franklin Wells, E. P. Allen.

STATE AGRICULTURAL COLLEGE.

(Under control of the State Board of Agriculture.)

FACULTY AND OTHER OFFICERS.

JONATHAN L. SNYDER, A. M., Ph. D., President; [a] [b] [c] Feb. 25, '96.

ROBERT C. KEDZIE, M. A., M. D., D. Sc., LL. D., Professor of Chemistry and Curator of the Chemical Laboratory; [a] [b] [c] Feb. 25, '63.

WM. J. BEAL, A. M., M. S., Ph. D., Professor of Botany and Forestry and Curator of the Botanical Museum; [a] [b] July 9, '70; [c] Feb. 22, '71.

LEVI R. TAFT, M. S., Professor of Horticulture and Landscape Gardening, and Superintendent of the Horticultural Department; [a] [b] [c] Aug. 1, '88.

HOWARD EDWARDS, M. A., LL. D., Professor of English Literature and Modern Languages: [a] [b] [c] Aug. 25, '90.

HERMAN K. VEDDER, C. E., Professor of Mathematics and Civil Engineering; [a] [b] [c] Sept. 15, '91.

CLINTON D. SMITH, M. S., Dean of Short Courses, College Extension Lecturer, and Superintendent of Institutes; [a] [b] Sept. 1, '93; [c] July 1, '99.

CHAS. L. WEIL, S. B., Professor of Mechanical Engineering and Director of the Mechanical Department; [a] [b] [c] Sept. 1, '93.

WALTER B. BARROWS, S. B., Professor of Zoölogy and Physiology, and Curator of the General Museum; [a] [b] [c] Feb. 15, '94.

GEORGE A. WATERMAN, B. S., M. D. C., Professor of Veterinary Science; [a] [b] [c] Sept. 1, '98.

MAUD RYLAND KELLER, A. M., Dean of the Women's Department: [a] [b] [c] Sept. 1, '98.

ARTHUR C. BIRD, B. S., M. Ag., Secretary; [a] [b] [c] Feb. 22, '99.

HERBERT W. MUMFORD, B. S., Professor of Agriculture and Superintendent of Farm; [a] Sept., '95; [b] Dec. 1, '96; [c] July 1, '99.

MAJOR CHARLES A. VERNOU, U. S. A., Professor of Military Science and Tactics; [a] [b] [c] Oct. 6, '00.

FRANK S. KEDZIE, M. S., Adjunct Professor of Chemistry; [a] [b] Sept. 15, '80; [c] Jan. 1, '91.

WILLIAM S. HOLDSWORTH, B. S., Assistant Professor of Drawing; [a] Feb. 22, '81; [b] Aug. 22, '87; [c] Jan. 1, '90.

WILBUR O. HEDRICK, M. S., Assistant Professor of History and Political Economy; [a] [b] Aug. 24, '91; [c] Sept. 1, '93.

WARREN BABCOCK, B. S., Assistant Professor of Mathematics; [a] [b] June 30, '91; [c] Sept. 1, '93.

CHARLES F. WHEELER, B. S., Assistant Professor of Botany; [a] [b] Mar. 1, '90; [c] Jan. 1, '96.

GEORGIANA BLUNT, Ph. M., Assistant Professor of English and Modern Languages; [a] [b] [c] Sept. 1, '98.

ULYSSES P. HEDRICK, M. S., Assistant Professor of Horticulture; [a] [b] [c] Sept. 1, '99.

JOSEPH A. JEFFERY, B. S. Agr., Assistant Professor of Agriculture; [a] [b] [c] Sept. 1, '99.

MARTIN D. ATKINS, A. B., Assistant Professor of Physics and Electrical Engineering; [a] [b] [c] Sept. 1, '99.

CHARLES E. MARSHALL, Ph. B., Assistant Professor of Bacteriology and Hygiene; [a] [b] [c] Sept. 1, '00.

HUGO DIEMER, M. E., Assistant Professor of Mechanical Engineering; [a] [b] [c] Sept. 1, '00.

CHARLES O. BEMIES, Director of Physical Culture; [a] [b] [c] Sept. 1, '99.

MRS. LINDA E. LANDON, Librarian; [a] [b] [c] Aug. 24, 91.

BURTON O. LONGYEAR, Instructor in Botany; [a] [b] [c] Feb. 15, '94.

RUFUS H. PETTIT, B. S. Agr., Instructor in Zoölogy; [a] [b] [c] Feb. 1, '97.

MRS. MAUD A. MARSHALL, Instructor in Music; [a] [b] [c] Sept. 1, '97.

MRS. JENNIE L. K. HANER, Instructor in Sewing; [a] [b] [c] Sept. 1, '97.

*WILLIAM O. BEAL, B. S., M. A., Instructor in Mathematics; [a] [b] [c] Sept. 1, '97.

CARRIE L. HOLT, Instructor in Drawing; [a] [b] [c] Sept. 1, '98.

CHACE NEWMAN, Instructor in Mechanical Drawing and Assistant in Woodwork; [a] [b] [c] Sept. 1, '97.

JOHN J. FERGUSON, B S. Agr., Instructor in Dairying; [a] [b] [c] Sept. 1, '99.

BELLE C. CROWE, Instructor in Domestic Science; [a] [b] [c] Oct. 1, '99.

E. SYLVESTER KING, Instructor in English; Jan. 1, '00.

ALBERT H. TAYLOR, Instructor in Physics; [a] [b] [c] Sept. 1, '00.

HERMAN W. REYNOLDS, B. S. in M. E., Instructor in Mechanical Engineering; [a] [b] [c] Sept. 1, '00.

LESLIE L. LOCKE, M. A., Instructor in Mathematics; [a] [b] [c] Sept. 1, '00.

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* Resigned Jan. 1, '00.

Alfred H. Parrot, M. A., Instructor in Mathematics; [a] [b] [c] Sept. 1, '00.

Bertha M. Wellman, B. S., B. Pd., Instructor in English; [a] [b] [c] Sept. 1, '00.

William T. Shaw, B. Agr., B. S., Instructor in Zoölogy; [a] [b] [c] Sept. 1, '00.

S. Fred Edwards, B. S., Instructor in Bacteriology; [a] [b] [c] Sept. 1, '00.

John Michaels, B. S. Agr., Instructor in Dairying; [a] [b] [c] Sept. 1, '00.

Carrie A. Lyford, B. L., Instructor in Domestic Science; [a] [b] [c] Sept. 1, '00.

Sarah S. B. Avery, Instructor in Gymnastics; [a] [b] [c] Sept. 1, '00.

Victor E. Brown, B. L., Instructor in English; [a] [b] [c] Sept. 1, '00.

Thomas Gunson, Instructor in Floriculture and Foreman of Greenhouse; [a] [b] April 1, '91; [c] March 1, '01.

Fred C. Kenney, Cashier; [a] [b] Sept. 18, '95; [c] Oct. 1, '97.

W. R. Bradford, Foreman of the Wood Shop; [a] [b] [c] Nov. 1, '97.

W. S. Leonard, Foreman of the Machine Shop; [a] [b] [c] Sept. 1, '96.

E. C. Baker, Foreman of the Foundry; [a] [b] [c] Nov. 1, '97.

E. R. Blair, Foreman of Farm; [a] [b] [c] Sept. 1, '99.

B. A. Faunce, Clerk to President; [a] [b] [c] Sept. 1, '99.

Clara A. Hinman, Bookkeeper; [a] [b] [c] May 1, '99.

L. F. Newell, Engineer; [a] [b] [c] Jan. 1, '98.

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[a] First appointment.
[b] Present appointment.
[c] Present title.

AGRICULTURAL EXPERIMENT STATION

OF THE

MICHIGAN AGRICULTURAL COLLEGE.

(Under the control of the State Board of Agriculture.)

STATION COUNCIL.

Clinton D. Smith, M. S., - Director.
J. D. Towar, B. S., - Agriculturist.
L. R. Taft., M. S., - Horticulturist.
Rob't C. Kedzie, M. A., M. D., D. Sc., LL. D., - - Chemist.
Chas. E. Marshall, Ph. B., - Bacteriologist and Hygienist.
A. C. Bird, B. S., M. Ag., Sec. and Treas.
J. L. Snyder, M. A., Ph. D., Pres., *Ex-officio* Member.

ADVISORY AND ASSISTANT STAFF.

H. W. Mumford, B. S., - - Experimenter in Live Stock.
M. L. Dean, - Assist. in Horticulture.
L. H. Van Wormer, B. S., - - - Assistant in Chemistry.
Geo. A. Waterman, V. S., M. D. C. Consulting Veterinarian.
Chas. F. Wheeler, B. S, - - Consulting Botanist.
R. H. Pettit, B. S. A., - - - Consulting Entomologist.
S. H. Fulton, B. S., In charge of South Haven Sub-Station.
Mrs. L. E. Landon, - - Librarian.
S. Fred Edwards, B. S., - - Assist. in Bacteriology and Hygiene.
Leo M. Geismer, Chatham, in charge of Upper Peninsula Experiment Station.

SUB-STATIONS.

Grayling, Crawford county, 80 acres deeded.
South Haven, Van Buren county, 10 acres rented; 5 acres deeded: Local Agent, S. H. Fulton, B. S.
Chatham, Alger county, 160 acres deeded; Local Agent, Leo M. Geismer.

STATE WEATHER SERVICE.

(Under the control of the State Board of Agriculture.)

OFFICERS OF THE SERVICE.

Director, - - - - - C. F. Schneider, U. S. Weather Service, Lansing.

STANDING COMMITTEE IN CHARGE.

Hon. Charles J. Monroe, - - - - - - - - - - South Haven.
Hon. Hollister F. Marsh, - - - - - - - - - - - Allegan.

ACCOUNTS OF THE STATE AGRICULTURAL COLLEGE.

FOR THE YEAR ENDING JUNE 30, 1901.

SECRETARY'S FINANCIAL REPORT.

			Dr.	Cr.
July 1, 1900.	To cash on hand		$2,680 90	
July 1, 1900.	To cash on deposit, college treasurer		11,261 53	
June 30, 1901.	To special appropriation receipts:			
	From State Treasurer	$77,500 00		
	From United States Treasurer	15,000 00		
	From institution	5,370 26		
			97,870 26	
June 30, 1901.	By special appropriation disbursements			$105,431 78
June 30, 1901.	To current account receipts:			
	From State Treasurer	$66,000 00		
	From United States Treasurer	25,000 00		
	From institution	33,885 53		
			124,885 53	
June 30, 1901.	By current account disbursements			130,188 90
June 30, 1901.	By cash on deposit, college treasurer			1,029 89
June 30, 1891.	By cash on hand			47 65
			$236,698 22	$236,698 22

TABLE No. 1.—*Tabular exhibit of secretary's report.*

Name of account.	Balance sheet, June 30, 1900.		Transactions July 1, 1900, to June 30, 1901.		Balance sheet, June 30, 1901.	
	Dr.	Cr.	Dr.	Cr.	Dr.	Cr.
Cash	$2,680 90		$2,633 25		$47 65	
College treasurer*	11,261 53		10,231 64		1,029 89	
Special appropriation		$8,555 94	97,870 26	$105,431 78		$461 39
General current		5,386 49	124,885 53	130,188 90		616 15
Total	$13,942 43	$13,942 43	$235,620 68	$235,620 68	$1,077 54	$1,077 54

* Treasurer's statement is greater July 1, 1900, by $9,288.14 warrants outstanding and June 30, 1901, by $4,615.10 less credits by remittance in transit of $1,913.23 and interest not credited $14.62.

TREASURER'S ACCOUNT.

	Dr.	Cr.
Balance on hand July 1, 1900	$20,549 67	
Receipts from State Treasurer and secretary	223,059 03	
Interest on deposits, 11 months at 2½ per cent	398 49	
Warrants paid July 1, 1900, to June 30, 1901		$240,260 81
Balance on hand June 30, 1901		3,746 38
	$244,007 19	$244,007 19

TABLE No 2.—*Statement of special appropriation account for fiscal year July 1, 1900, to June 30, 1901.*

Name of appropriation.	Balance of account, June 30, 1900.		Receipts during fiscal year.		Total available.	Total expended.	Balance of account, June 30, 1901.	
	Dr.	Cr.	From state treasury.	From institution.			Dr.	Cr.
Experiment station		$487 41	*$15,000 00	$3,971 82	$19,459 26	$18,843 11		$616 15
Weather service		10 11	1,000 00	8 25	1,018 36	991 49		26 87
Repairs of buildings			5,000 00	33 64	5,033 64	5,033 64		
Farmers' institutes			5,500 00	9 63	5,509 63	5,509 63		
Student labor			2,500 00		2,500 00	2,500 00		
Women's Building		7,742 43	33,000 00	30 47	40,772 90	40,772 90		
Heating and furnishing women's building	$1,128 13		11,000 00	583 76	10,455 63	10,455 63		
Farm barn		777 96	1,000 00	160 00	1,937 96	1,937 96		
Upper Peninsula experiment station		622 95	3,500 00	134 69	4,257 64	4,257 64		
Dairy building	166 82		15,000 00		14,833 18	14,581 78		251 40
Nursery license and inspection		210 00		†438 00	648 00	548 00		100 00
Balance	8,555 94						$994 42	
Totals	$9,850 89	$9,850 89	$92,500 00	$5,370 26	$106,426 20	$105,431 78	$994 42	$994 42

* $15,000 from United States Treasury.

† $438 from nursery license and inspection of orchards.

TABLE NO. 3.—*Current account July 1, 1900, to June 30, 1901.*

On account of—	Dr. To disbursements.	Cr. By receipts.
U. S. Treasurer, twelfth annual payment under act of congress of August 30, 1890		$25,000 00
State Treasurer interest on proceeds of sales of U. S. land grant		66,000 00
Salaries paid	$50,384 76	
Farm department	13,513 21	7,815 96
Horticultural department	5,139 99	2,348 04
Mechanical department	6,164 89	1,176 04
Heating department	13,023 28	1,791 15
Cleaning department	1,474 37	85 92
Electric lighting department	2,895 36	926 16
Office	1,026 25	50 26
Advertising	2,342 34	
M. A. C. Record	796 23	590 93
Special courses	2,169 19	818 33
Academic departments	11,526 58	2,814 77
Contingent building	15,609 13	14,535 28
Miscellaneous	4,123 32	932 69
	$130,188 90	$124,885 53
Balance at beginning of period July 1, 1900		5,386 49
Balance at close of period June 30, 1901	83 12	
	$130,272 02	$130,272 02

TABLE NO. 4.—*Experiment station account, July 1, 1900, to June 30, 1901.*

On account of—	Dr. To disbursements.	Cr. To receipts.
Balance from last fiscal year, July 1, 1900		$487 44
U. S. Treasurer for fiscal year		15,000 00
Fertilizer license fees		1,960 00
Salaries paid	$9,108 01	
Farm department	3,709 77	1,516 07
Horticultural department	481 58	
Chemical department	507 29	
Botanical department	53 31	
Entomological department	77 73	
Building	93 50	
Library	177 68	
Sundry	1,706 71	17 23
Secretary's office	428 17	86
South Haven sub-station	1,514 50	384 34
Apiary	3 55	
Bacteriological	981 31	93 32
Balance on hand June 30, 1901, close of fiscal year	616 15	
	$19,459 26	$19,459 26

TABLE NO. 5.—*Regular employes and salaries.*

Officers.	Rate per year.	Classification.		Other sources.	
		Current.	Experim't station.		
President	$3,200 00	$3,200 00			Dwelling.
Professor of chemistry	2,000 00	1,700 00	$300 00		“
“ “ botany	1,800 00	1,800 00			“
“ “ horticulture	1,800 00	400 00	1,400 00		“
“ “ English	2,000 00	2,000 00			
“ “ mathematics	1,800 00	1,800 00			Dwelling.
College extension lecturer, director of experiment station	2,000 00	400 00	1,000 00	$600 00	“
Professor of mechanical engineering	1,800 00	1,800 00			“
“ “ zoology	1,800 00	1,800 00			“
“ “ veterinary science	1,500 00	1,200 00	300 00		
Dean of women's department	1,100 00	1,100 00			Rooms.
Secretary	1,800 00	300 00	500 00	1,000 00	Dwelling.
Professor of agriculture	2,000 00	1,800 00	200 00		
“ “ military science	576 00	576 00			
Adjunct professor of chemistry	1,800 00	1,800 00			
Assistant professor drawing	1,250 00	1,250 00			Rooms.
“ “ his. and pol. economy	1,000 00	1,000 00			“
“ “ mathematics	1,000 00	1,000 00			“
“ “ botany	1,000 00	500 00	500 00		“
“ “ English	1,050 00	1,050 00			
“ “ horticulture	1,500 00	1,500 00			Rooms.
“ “ agriculture	1,400 00	1,400 00			
“ “ physics	1,450 00	1,450 00			Rooms.
“ “ bacteriology	1,400 00	400 00	1,000 00		
“ “ mechanical engineering	1,200 00	1,200 00			
Director physical culture	1,000 00	1,000 00			Rooms.
Librarian	725 00	605 00	120 00		“
Instructor in botany	600 00	600 00			
“ “ mechanical engineering	800 00	800 00			
“ “ zoology	1,000 00	500 00	500 00		Dwelling.
“ “ music	600 00	600 00			
“ “ sewing	700 00	700 00			Rooms.
“ “ mathematics	500 00	500 00			
“ “ “	500 00	500 00			
“ “ drawing	500 00	500 00			
“ “ mechanical drawing	600 00	600 00			
“ “ animal husbandry	800 00	800 00			Room.
“ “ domestic science	800 00	800 00			“
“ “ English	750 00	750 00			
“ “ “	500 00	500 00			
“ “ physical culture	300 00	300 00			Room.
“ “ cookery	300 00	300 00			“
“ “ dairying	500 00	500 00			“
“ “ physics	500 00	500 00			
“ “ bacteriology	200 00	200 00			
Foreman greenhouse	1,000 00	1,000 00			Dwelling.
“ machine shop	900 00	900 00			
“ wood shop	600 00	600 00			
“ foundry	600 00	600 00			
Cashier	1,000 00	800 00	200 00		
Foreman college farm	500 00	500 00			Dwelling.
Clerk to president	600 00	600 00			
Engineer	700 00	700 00			Dwelling.
Bookkeeper	600 00	500 00	100 00		
Clerk to secretary	420 00	320 00	100 00		
“ “ mechanical department	420 00	420 00			
Assistant gardener	700 00	100 00	600 00		
“ greenhouse	384 00	384 00			
Agriculturalist	1,500 00		1,500 00		
Assistant in chemistry	500 00		500 00		
Stenographer to director experiment station	420 00		210 00	210 00	
Night watchman	420 00	420 00			
Assistant Librarian	300 00	300 00			
Totals	$62,965 00	$52,125 00	$9,030 00	$1,810 00	

‡TABLE NO. 6.—*Detailed statement of Legislative*

Object.	Total.	1899.	1897.	1895.	1893.
Buildings		Women's dormitory... $83,000 Heating and furnishing dormitory... 12,000 Dairy building... 15,000 Farm barn... 4,000 Heating apparatus... 2,500 Fire escapes... 500	Electric light plant... $5,000 Bath room, Abbot hall.. 200	Closets...	Equip. botanical lab... $1,000 Foundry... 1,500 Hospital... 2,500
Total for buildings	$351,325 00	$117,000 00	$5,200 00	$3,000 00	$5,000 00
General account	466,655 57				
Repairs	87,388 60	10,000 00	12,000 00	12,000 00	13,500 00
Library	25,055 00				2,000 00
Farm	26,175 64				900 00
Garden	11,991 00				200 00
Greenhouse	2,765 00				
Botany	5,331 00				
Chemistry	13,955 00				
Zoölogy	10,296 00				225 00
Veterinary	2,586 00				
Mathematics	6,090 00				500 00
Mechanical	15,200 00				
Steam and water	20,832 00				
Institutes	41,800 00	11,000 00	11,000 00	10,000 00	4,000 00
Student labor	58,000 00	5,000 00	5,000 00	8,000 00	8,000 00
Weather service	22,937 50	2,000 00	2,000 00	2,000 00	
Sundry	8,960 00				3,400 00
Totals	$1,173,343 31	$145,000 00	$35,200 00	$35,000 00	$37,725 00
Annual tax on each $1,000 of assessment	† $0.035	$0.0656	$0.0155	$0.0155	$0.01⅜
*Aggregate tax to date on each $1,000 of assessment		$2.2301	$2.0989	$2.0679	$2.0369
Assessed valuation of State in millions of dollars		1,105.10	1,105.10	1,130	1,130

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*Counting only taxes actually levied and omitting land grants.

† Average.

‡ The legislature of 1901 provided for a permanent annual income of $100,000 in lieu of special legislative appropriations except $1,000 for the State weather service.

appropriations to the State Agricultural College.

1891.	1889.	1887.	1885.	1883.	1881.	1879.	1877.	1855–75.
Botanical laboratory.... $10,000 Heating apparatus...... 1,950 Greenhouse.......... 4,500	Agricultural laboratory. $8,000 Sundry.............. 1,800	Howard terrace........ $10,000 Abbot hall.......... 10,000 Horticultural lab....... 5,000 Mechanical laboratory.. 3,000 Bridge, etc............ 2,100	Mechanical laboratory.. $7,800 Veterinary laboratory.. 5,400 Armory.............. 5,000 One dwelling.......... 4,000	Boiler house.......... $5,000 One dwelling.......... 3,000	Library.............. $25,000 Chemical lab. addition.. 6,000 Barns................ 2,775	Botanical laboratory.... $6,000 One dwelling.......... 3,000	Wells hall............ $25,000	Williams hall, 1869..... $30,000 Chemical lab., 1871...... 10,000 Greenhouse, 1873........ 8,000 Three dwellings......... 18,000 Bridges.............. 800
$16,450 00	$9,800 00	$30,100 00	$22,200 00	$8,000 00	$33,775 00	$9,000 00	$25,000 00	$66,800 00
....	....	....	....	16,770 00	14,498 00	9,943 60	12,300 00	413,143 97
7,800 00	5,000 00	1,400 00	3,147 00	6,720 00	1,576 00	1,290 00	3,691 60	9,264 00
2,000 00	3,000 00	3,000 00	3,300 00	3,125 00	3,000 00	2,000 00	1,190 00	2,440 00
2,100 00	800 00	2,815 00	4,810 00	3,389 00	4,175 00	4,016 64	2,400 00	1,670 00
570 00	500 00	1,250 00	432 00	1,342 00	3,220 00	2,810 00	947 00	720 00
530 00	600 00	340 00	1,295 00	....	....	....	....	....
500 00	1,000 00	800 00	800 00	2,231 00	....	....	....	....
500 00	1,500 00	2,000 00	2,500 00	1,000 00	3,000 00	1,000 00	1,380 00	1,075 00
700 00	1,500 00	1,500 00	1,500 00	1,945 00	1,000 00	800 00	480 00	646 00
100 00	200 00	200 00	2,086 00	....	....	....	....	....
200 00	475 00	600 00	450 00	700 00	2,020 00	1,020 00	125 00	....
1,500 00	3,200 00	4,000 00	5,200 00	1,000 00	300 00	....	....	....
2,045 00	2,920 00	7,500 00	1,400 00	4,267 00	....	....	....	2,700 00
1,500 00	800 00	600 00	600 00	600 00	600 00	600 00	500 00	....
8,000 00	8,000 00	8,000 00	8,000 00	....	....	....	....	....
....	8,350 00	8,587 50	....	....	....	....	....	....
1,400 00	500 00	2,100 00	....	....	....	600 00	660 00	300 00
$45,895 00	$48,145 00	$74,792 50	$57,720 00	$51,089 00	$67,164 00	$33,080 24	$48,673 60	$498,758 97
$0.02	$0.02½	$0.04	$0.03⅓	$0.04⅐	$0.04⅐	$0.02⅝	$0.04	$0 0747
$2.0036	$1.963	$1.912	$1.833	$1.7657	$1.7026	$1.6197	$1.5672	$1.4407
1,330	945.15	945.45	810	810	810	630	630	137 to 630

TABLE NO. 7.—*Income of the State Agricultural College from all outside sources from the date of its foundation to the present time.*

Year.	From State Legislature.			From U. S. Congress.			Total.
	For current expenses.	For special purposes.	Land sales salt spring and swamp land grants.	Morrill act of 1862, interest from land grant and trespass.	Hatch act of 1887, experiment station.	Morrill act of 1890, supplementary endowment.	
1855			$56,320 00				$56,320 00
1856							
1857	$40,000 00						40,000 00
1858							
1859	37,500 00						37,500 00
1860							
1861	6,500 00		152 25				6,652 25
1862	10,000 00		218 97				10,218 97
1863	9,000 00		407 80				9,407 80
1864	9,000 00		726 09				9,726 09
1865	15,000 00		1,156 61				16,156 61
1866	15,000 00		1,094 27				16,094 27
1867	20,000 00		7,608 38				27.608 38
1868	20,000 00		592 49				20,592 49
1869	20,000 00	$30,000 00	17,559 00	$58 96			67,617 96
1870	20,000 00		1,320 02	2,720 93			24,040 95
1871	18,250 00	10,500 00	4,135 72	3,785 84			36,671 56
1872	18,250 00	3,000 00	217 05	7,175 65			28,642 70
1873	21,796 00	15,602 00	10 13	11,059 06			48,467 19
1874	13,000 00	15,602 00	150 13	14,061 98			42,814 11
1875	7,638 00	7,755 50	144 53	14,446 14			29,984 17
1876	7,638 00	6,755 50	1,773 09	16,830 17			32,996 76
1877	6,150 00	30,686 80	979 06	15,172 86			52,988 72
1878	6,150 00	5,686 80	826 60	15,807 09			28,470 49
1879	4,971 80	16,068 32	712 22	16,978 22			38,730 56
1880	4,971 80	7,068 32	797 55	17,837 24			30,674 91
1881	7,249 00	43,720 50	461 95	20,935 25			72,366 70
1882	7,249 00	8,945 50	358 46	22,507 45			39,060 41
1883	8,385 00	23,793 00	391 95	30,749 60			63,319 55
1884	8,385 00	10,526 00	1,259 90	27,909 72			48,080 62
1885		35,103 00	187 50	29,770 40			65,060 90
1886		22,617 00		30,461 04			53,078 04
1887		* 44,040 00	† 198 20	† 24,611 37			68,849 57
1888		30,752 50	144 20	32,406 60	$15,000 00		78,303 30
1889		* 20,973 00	10 50	31,322 69	15,000 00		67,306 19
1890		* 27,172 00	238 50	32,360 64	15,000 00	$15,000 00	89,771 14
1891		22,947 50	37 38	34,750 54	15,000 00	16,000 00	88,735 42
1892		22,947 50	137 38	34,948 12	15,000 00	17,000 00	90,033 00
1893		18,862 50	10 50	37,927 04	15,000 00	18,000 00	89,800 04
1894		18,862 50	433 59	44,527 26	15,000 00	19,000 00	97,823 35
1895		‡ 19,000 00	10 50	45,301 85	15,000 00	20,000 00	99,312 35
1896		‡ 16,000 00		44,037 25	15,000 00	21,000 00	96,037 25
1897		‖ 17,700 00		43,779 54	15,000 00	22,000 00	98,479 54
1898		¶ 17,500 00		45,190 17	15,000 00	23,000 00	100,690 17
1899		§ 8,750 00	705 00	50,402 90	15,000 00	24,000 00	98,857 90
1900		§ 72,500 00	175 00	75,452 09	15,000 00	25,000 00	188,127 09
1901‖‖		§ 72,500 00		63,976 69	15,000 00	25,000 00	176,476 69
Totals	$362,083 60	$723,937 74	$101,662 47	$939,232 25	$210,000 00	$245,000 00	$2,581,946 16

* Including appropriations for weather service.
† October 1, 1886, to June 30, 1887, nine months.
‡ Including $5,000 for institutes and $1,000 for weather service.
§ Including $2,750 for institutes and $500 for weather service.
‖ Including $5,500 for institutes and $1,000 for weather service.
¶ Including $5,500 for institutes and $1,000 for weather service.
‖‖ To June 30.

SUMMARY OF INVENTORY, JUNE 30, 1901.

College farm and park, 671 acres @ $70		$46,970 00
Athletic field and drive, 13 acres @ $87.50		1,137 50
Buildings—		
Library and museum, built 1881	$22,000 00	
College hall, built 1856	17,000 00	
Williams hall, built 1869	30,000 00	
Wells hall, built 1877	20,000 00	
Abbot hall, built 1888, add. in 1896	15,000 00	
Chemical laboratory, built 1871, south end add. '81	18,000 00	
Machine shops and foundry, 1885, so. end add. '87	15,000 00	
Veterinary laboratory, built 1885	5,000 00	
Horticultural laboratory, built 1888	6,000 00	
Agricultural laboratory, built 1889, imp. 1897	7,500 00	
Botanical laboratory, built 1892	10,000 00	
Armory, built 1885	6,000 00	
Greenhouse and stable, built 1873, 1879; rebuilt '92	6,000 00	
Greenhouse, experiment, built 1889	1,300 00	
Boiler house and chimney, built 1893-4	4,000 00	
President's and two frame dwellings, built 1874	12,000 00	
Four brick dwellings, built 1857	10,000 00	
Two brick dwellings, built 1879 and 1884	6,000 00	
One frame dwelling, built 1885	3,500 00	
Howard terrace dwelling, built 1888	13,000 00	
Farm house dwelling, built 1869	2,000 00	
Herdsman's dwelling, built 1867	400 00	
Ten barns at professors' houses	2,000 00	
Horticultural barn and shed, built 1868, 1875, 1887	1,200 00	
Cattle barn and shed, built 1862	1,500 00	
Sheep barn, built 1865	1,000 00	
Horse barn, built 1871	1,000 00	
Pig barn, built 1871	1,000 00	
Corn barn, built 1878	400 00	
Grain barn, built 1881	1,600 00	
Horse sheds, built 1894	200 00	
Tool barn, built 1881	1,000 00	
Barn, built 1884	800 00	
Brick work shop, built 1857	500 00	
Observatory, built 1880	150 00	
Bath house and fittings, built 1889	400 00	
Ice house, 1879	100 00	
Paint shop, built 1879	150 00	
Bee house, 1884, remodeled dwelling, 1893, add. 1900	1,000 00	
Hospital, 1894	3,000 00	
Poultry building and yards, 1894	625 00	
Dairy barn, built 1897	800 00	
Waiting room street car terminus, built 1897	80 00	
Street car track and fixtures, 600 ft., built 1897	360 00	
Lumber shed, mechanical department	250 00	
Silo	210 00	
Coal shed, built 1899	700 00	
Woman's building, built 1900	91,000 00	
Farm barn, built 1900	4,000 00	
Dairy building, built in 1900	15,000 00	
		359,725 00
Iron bridge over Cedar river, built 1888		1,500 00
Amount carried forward		$409,332 50

Amount brought forward		$409,332 50
Water works and steam works—		
Artesian well and connections, sunk '87, 343 ft. deep.	$1,000 00	
Artesian well and connections, sunk '99, 345 ft. deep.	700 00	
Fire pump, 1883, $650; tank pump, 1881, $200	850 00	
Three hose carts and 4 nozzles, bought 1883-88-00	114 00	
2,378 ft. wood pipe, 6 in., laid 1883-87	1,531 00	
2,623 ft. wood pipe, 4 in., laid 1883-87		
662 ft. wood pipe, 3 in., laid 1883-87		
1,500 ft. wrought iron pipe, 3 in., laid in 1898	460 00	
One thousand feet fire hose	240 00	
Water tank and heater, built 1883	518 00	
Thirteen fire hydrants in place, built 1883-87	460 00	
Valves, fittings and connections, laid 1883-87	660 00	
Four boilers, 4 ft. x 12 ft., built 1881	644 00	
Two boilers 5 ft. x 12 ft., built 1887	1,080 00	
One boiler, 6 ft. x 18 ft., built in 1900	1,150 00	
Two small pumps, 1884-91	200 00	
Underground steam piping, laid 1882	2,500 00	
Miscellaneous tools and stock	341 20	
One water purifier	325 00	
Two water meters	90 00	
Injector	22 00	
Main steam pipe, 1892	300 00	
Safety valve on water main	15 00	
One pile hammer	10 00	
Six service boxes, in place 1893	20 00	
Six lawn hydrants, in place 1894	20 00	
Five-inch exhaust head	10 00	
Three fire hydrants, 1898	18 00	
1,200 ft. 3-inch iron water main, 1898	160 00	
Steel benching, put in in 1895	295 00	
College hall steam main, 1898	1,500 00	
Agricultural laboratory steam line, 1897	1,000 00	
2 L. & D. boiler feed pumps	285 00	
2 Kokomo telephones	28 00	
1 electric line and cons. to Williams hall tank	3 00	
One Worthington feed pump	28 00	
Valve reseating machine	125 00	
One hopper and fixtures	352 00	
One covering for same	155 00	
Steam lines, 1900	700 00	
Sewer line, 1900	600 00	
		18,509 20
Farm Department—		
Feed	$212 50	
Cattle	6,841 30	
Sheep, 70 head	1,173 50	
Horses	625 00	
Swine	266 50	
Tools, implements, scales, windmills, etc	1,486 31	
Class rooms, office and farm house equipment	2,869 72	
Wood for delivery	839 37	
Growing crops, estimated	1,118 70	
Dairy room	744 50	
		16,177 40
Amount carried forward		$444,019 10

Amount brought forward		$444,019 10
Horticultural Department—		
Animals in Zoo	$294 00	
Pruning tools	11 15	
Teams, harness, etc.	572 25	
Heavy tools	432 90	
Compost and manures	50 00	
Carpenters' tools	28 56	
Ice tools	37 50	
Office	150 25	
Class room	759 50	
Tool room	219 81	
Greenhouse plants	2,210 55	
Vegetable garden	41 50	
Laboratory furniture, etc.	91 50	
Greenhouse tools	256 45	
Work room	7 00	
		5.162 92
Mechanical Department—		
Class room and office equipment	$7,045 09	
Machine shop	8,374 42	
Wood shop	2,843 91	
Blacksmith shop and foundry	1,882 25	
		20.145 67
Botanical Department—		
Herbarium	$8,126 31	
Museum	900 75	
Office class apparatus, garden tools, etc	3,471 37	
		12,498 43
Mathematical and Engineering Department—		
Surveying instruments	$2,337 10	
Telescope and accessories	839 75	
Furniture, apparatus, etc.	1,005 00	
Photographic material	47 40	
Office furniture	307 28	
		4,536 53
Library, exclusive of experiment station library—		
20,379 bound books	$40,758 00	
8,000 pamphlets	160 00	
Sunday school books	130 00	
Portrait and pictures	1,110 00	
Furniture	819 51	
		42,977 51
Chemical Department—Furniture, apparatus and chemicals	$12,369 76	
Physicial Department—Fixtures and apparatus	6,878 06	
Veterinary Laboratory—Museum furniture and apparatus	1,838 40	
Zoölogical Department—Furniture and apparatus	1,911 90	
General Museum—Collections and cases	17,818 75	
History and Economics Department	138 00	
College hall furniture and English department	987 75	
Drawing	1,353 37	
Public parlor furniture, $50.80; hospital furniture, $118.92	169 72	
President's office	699 89	
Secretary's office	1,767 72	
Armory—Furniture and equipment	689 90	
Women's department	6,028 00	
State Board of Agriculture rooms	411 69	
Farmers' institute	779 46	
Amount carried forward	$53,842 37	$529,340 16

Amount brought forward	$53,842 37	$529,340 16
Athletic apparatus	600 60	
Electric light plant, complete	7,000 00	
One dynamo at agricultural laboratory	280 00	
Advertising	67 00	
Bacteriological Department	1,423 64	
Furniture in postoffice	20 25	
Miscellaneous furniture	428 00	
Carpenter shop equipment	500 00	
Lumber in stock	500 00	
Michigan Weather Service	1,888 42	
		66,550 28
Experiment station		31,261 83
Total		$627,152 27
United State property held in trust—		
Two 3 inch rifled guns and equipments	$1,573 55	
250 Springfield rifles, complete	3,750 00	
250 rifle equipments	665 00	
Reloading tools, chests, tarpaulins, etc	83 55	
		$6,072 10

SUMMARY OF EXPERIMENT STATION INVENTORY.

Lands donated to the Station—		
80 acres at Grayling, fenced and improved at cost	$1,000 00	
5 acres at South Haven, fenced and improved	1,000 00	
160 acres at Chatham, including buildings	4,000 00	
		$6,000 00
Buildings—		
Experiment feed barn	$800 00	
Horticultural laboratory, experimental rooms	1,200 00	
Veterinary laboratory, experimental rooms	250 00	
Apiary	600 00	
Forcing houses, $1,500.00–$600.00	2,100 00	
Feed mill	100 00	
Sub faculty building	3,000 00	
Seed room	980 00	
Poultry house and yards	625 00	
Dairy room in agricultural laboratory	250 00	
Storage barn	600 00	
Cold storage fruit house	1,500 00	
		12,005 00
Library and office of secretary—		
1,944 books	$3,888 00	
2,000 pamphlets	40 00	
Furniture and mailing list in type	450 00	
		4,378 00
Farm Department—		
Field crops	$345 00	
Permanent fixtures	115 00	
Office	457 25	
Tools and implements	604 88	
Poultry	220 25	
Stock	113 50	
Fertilizers and grains	203 40	
Dairy	57 75	
		2,117 03
Horticultural Department—		
Office, furniture, implements, etc	$617 75	
One team	200 00	
		817 75
Chemical Department—		
Porcelain	$26 54	
Glassware	96 45	
Furniture and fixtures	180 10	
Chemicals	37 30	
Apparatus	1,480 44	
		1,820 83
Botanical Department—		
Microscopes and accessories	$316 88	
Furniture and sundry apparatus	216 11	
		532 99
Bacteriological Department—		
Instruments and sundry apparatus	$2,207 83	
Chemicals	326 63	
		2,534 46
Zoölogical Department—		
Microscopes, cases, etc.		749 44
Upper Peninsula Experiment Station, office, tools, etc		183 63
South Haven Experiment Station, office, tools, etc		122 70
Total		$31,261 83

DEPARTMENT REPORTS.

REPORT OF THE PRESIDENT.

To the Honorable State Board of Agriculture:

Gentlemen—I have the honor to submit herewith my report for the year ending June 30, 1901, accompanied by those of the professors in charge of the several departments.

I take pleasure in reporting that good work has been done in all departments during the past year. The attendance has been larger than ever before, and a spirit of earnestness has characterized the work of the student body. During the year the enrollment was 552. The increase over last year is twenty-five. It would have been larger had not the requirements for entrance been more rigidly enforced. Quite a number were refused admission and others were advised to take one more year for further preparation in the public schools before endeavoring to enter this institution. In consequence of this action there were not so many failures as in previous years. It has been the aim of the institution to maintain a high standard of work. At the end of each term a committee on doubtful cases goes over the record of each student carefully, and those who have fallen below a reasonable standard are requested not to return. This year at the end of the fall term four students were dropped, at the end of the winter term six, and at the end of the spring term seven. It is now quite well understood among the students that if their work be of such a character as to call in question their ability to do successful work during the next term, they are liable to be requested not to continue in college longer.

COLLEGE HOSPITAL.

A college hospital containing seven rooms with two bath rooms was built in 1893 at a cost of $3,500. This hospital, until the beginning of last year, was occupied by different parties, sometimes college employes, who were expected to take care of students when ill. At no time was the service altogether satisfactory. At the opening of last term Miss Rowena Ketcham, a trained nurse, was employed and placed in charge. The College agreed to pay her $300 and permit her to collect five dollars per week from such students as were confined in the hospital. There was very little illness during the fall term, but quite a number were in the hospital during the winter and spring terms. There were, however, no serious cases excepting that of Norman Edwards, the son of Dr.

Howard Edwards, professor of English. After several weeks' illness this young man was taken to his old home in Virginia where he died. Several Lansing doctors pronounced the case malarial fever. The doctors in Virginia diagnosed it as typhoid fever. The hospital service during the past year has been very satisfactory. Students seemed to appreciate the services of Miss Ketcham and were almost always ready and willing to go to the hospital when ill. The building has been fitted up with neat, small iron bedsteads, and is in every way very neat and comfortable. Serious illness is often avoided by prompt removal to the hospital and such special care as only a trained nurse can give.

The women's building was ready for occupancy at the beginning of the year. In addition to the teachers of this department sixty-six young women lived in this building. The effect of this beautiful and commodious home has had a marked influence upon the young women. The building was dedicated on the 25th of October. It was pre-arranged to have the State Federation of Women's Clubs meet in Lansing at such a time as would be suitable to dedicate this building. Invitations were also issued to all the granges and farmers' clubs of the State to be represented on this occasion by one delegate. About 250 representing the various women's clubs and about 50 representing granges and farmers' clubs, besides many other visitors from a distance, were present. The dedicatory exercises were held at 10 o'clock in the Armory. The building was crowded, over 1,000 being present. After music, and prayer by the Rev. E. B. Allen, the president of the College gave a brief description of the building and also of the efforts put forth to establish a women's department and provide for it a commodious home. Miss Maud R. Keller, dean of the women's department, warmly welcomed the visitors and spoke of the work of the department. Mrs. Nellie Kedzie, professor of household economics in the Bradley Polytechnic Institute, Peoria, Ill., spoke on the "American Queen." Miss Mary Evans, president of the Lake Erie College for women, gave an address on "Culture in the College Home." Mrs. Anna A. Palmer presented a valuable paper on "Education for Practical Life," and Mrs. Marie B. Ferry spoke on "Educational Debts and Dangers." Mrs. Inman, of Grand Rapids, presented a collection of books which were donated to the women's department by the various women's clubs of the State. Mrs. Mary A. Mayo, who was to represent the grange on this occasion, was not able to be present on account of the illness of her daughter. The meeting closed shortly after 12 o'clock when invited guests to the number of 450 repaired to the Women's Building where a bountiful banquet was served by the women's department in the dining room and corridor on the third floor. Dr. Kedzie, in his inimitable style, served as toast master. The following responses were made: Dr. Eliza Mosher, of the University of Michigan, on the "Evolution of True Womanliness"; Miss Julia King, of the State Normal College at Ypsilanti, "Greetings from the Normal Schools"; Mrs. Ella Rockwood, "The Twentieth Century Girl"; the Hon. Jason E. Hammond, "The Boy's Side"; Mrs. Root, of Bay City, in behalf of the Washington Tree League, presented some little trees with the request that they be set out on the campus. The Hon. L. Whitney Watkins spoke of "The Country for Girls"; Hon. C. J. Monroe told of some things to be hoped for from the Women's Department; Miss Julia Ball, of Hamburg, spoke of "Women as Helpmeets Rather Than Competitors of Man"; and Mrs. Martha A. Keating, of Muskegon, president of the State Federation of Women's Clubs, spoke of the "College Woman." It is very much regretted that the addresses on this occasion were not given permanent form in print. They were of an unusually high order and would be read by the future young women in this department with great interest and profit. This occasion was a notable one in the history of the College. There perhaps has never been before so large a gathering of representative women in the State. Great interest was shown by all in the Women's Department, and praises of the Women's Building will no doubt now be sung in all parts of the commonwealth.

The Dairy Building, which was in course of construction during the past year, was completed in December, and was dedicated on February 7. The State Dairymen's Association held its annual meeting at the College at this time, and one session of the meeting was given up to the dedicatory exercises. The following program was carried out:

Music—"Where are you going my pretty maid?" - - - Double Quartet.
"Legislation for the Dairy School," - - - - Hon. J. W. Helme, Jr.
"The Dairy School and the manufacture of Dairy Products," -
Hon. Geo. B. Horton, Worthy Master, Michigan State Grange.
Music—Vocal solo - - - - - - - - - - - - - Miss Hadley.
"The Benefits of the Dairy School to the Butter Maker," Mr. Jno. Ruff, St. Clair.
"The Rise of the Dairy Schools," - - - - - - Hon. R. A. Pearson,
Asst. Chief of the Dairy Division, Washington, D. C.
Music—Our Old Kentucky Home, - . - - - - Double Quartet.
"The relation of the Special Courses to the Regular College Work," - - -
President J. L. Snyder.
Inspection of the dairy building.

This building is all that could be desired for the money expended. It will serve the purposes for which it is intended for many years to come.

LEGISLATION.

We felt proud two years ago when the Legislature granted the College $95,000 for the Women's Building and furnishings, $15,000 for a Dairy Building, and $4,000 for a barn, together with other appropriations amounting in all to $132,000. The last Legislature, however, did even better than this. It had been felt for some time that the College had reached such a stage in its development that it should have a permanent income for building purposes. It has been difficult in the past to plan for the future when it was not known what the next Legislature would do. After careful deliberation the Board decided to ask the Legislature for a tax of 1-15 of a mill on the taxable property of the State. The House committee, however, of whom Mr. B. A. Nevins of the class of '74 was chairman, decided to make an appeal for 1-10 of a mill, and include in this bill the funds necessary to support the farmers' institutes, Northern Peninsula Experiment Station, student labor, repairs to buildings, etc., for which in the past special appropriations have been made. In addition to this it was decided later to limit the amount to $100,000. In this form the bill passed both houses and received the signature of the Governor. As the 1-10 of a mill amounts to over $110,000, it is safe to say that in the future the College will receive from this act $100,000 per year. After providing for the items mentioned above, there will be left for the present between sixty and seventy thousand dollars per annum for building purposes. This can be put to splendid use in meeting the following needs of the College:

IMPROVEMENTS.

Without making any attempt to classify these needs in the order in which they should be responded to by the College, the following improvements are very imperative:

Heating and water plant. Our present heating system was inaugurated nineteen years ago. It was then extended to only two or three buildings. To these have been added other buildings from year to year until at present the old system is extended to almost all the large buildings on the campus. In many instances the extension was of a cheap and inferior order. Breaks are frequent and much of the heat radiates into the ground. The boilers are old and unsafe. To heat the buildings erected last year—the Women's Building and the Dairy—a temporary arrangement has been provided by the erection of a boiler near the Women's Building. This makes it necessary to keep two sets of firemen.

Our water system was also put in operation nineteen years ago. Wooden pipes were used. These have become leaky and an unnecessary waste is going on all the time. The most perplexing trouble, however, comes from the fear of fire. We have our system so arranged that we can connect with the river at once and use our large pump, but it is feared by our engineer that if we were to put a heavy pressure on these old pipes they would burst. It is not believed by those in a position to know that these old wooden pipes would stand sufficient pressure to force the water to the top of one of our high buildings. We should have a new heating and water system. There should be tunnels run across the grounds in which all the pipes and wires could be placed. It is estimated that a proper system would cost about $60,000.

In our mechanical engineering course we have 222 students. We have the same shop room, drawing rooms, etc., as were thought necessary for the department when it numbered only about 90 students. We now divide the classes into sections so that the more crowded shops can be kept running practically all the time. Even with this arrangement it is almost impossible to find accommodations. Every lathe is taken and with the increase that is sure to come in this department we must have more room in order to accommodate them. Our present building, while it has answered the purpose up to the present time fairly well, is a cheap structure, costing, all told, about $15,000. This building should be used exclusively for shops and our Engineering Department should have a new building,—one costing fifty or sixty thousand dollars. It could at once be put to excellent service in providing rooms for drawing, drafting, class rooms and engineering work.

Auditorium and Library. The old chapel seats less than 200 persons. If all our students today desired to attend our exercises only about one-third of them could be accommodated. There is no opportunity to call the students together and address them in a body. The incentive to attend religious exercises is very much stultified at the beginning of each term when a great many are turned away for lack of room. For our lecture course and for other large meeting we are required to use the Armory. This necessitates the hauling of chairs to the extent of six or eight hundred and disposing of them again the next morning. By this arrangement the work of the Military Department is interfered with considerably. It is very difficult to arrange for public meetings under these circumstances, and while it is desirable at times to have the students assemble, under present conditions it is practically out of the question.

Our library consists of 21,000 volumes valued at an average price of two dollars per volume. A great many of these books could not be replaced if destroyed by fire. There is perhaps no other place in the country where such a valuable collection of books is housed in a building which is not fire proof. Our present room is over crowded and no longer affords proper accommodation for our great body of students. A fire-proof library and auditorium, such as our present needs demand, would cost about $80,000.

Physics and electrical engineering. The Department of Physics and Electrical Engineering is located in the north end of the building occupied by the Chemical Department. This arrangement was satisfactory when the College had but 200 students, but at the present time there are 220 students studying chemistry, and 170 studying physics. It is simply impossible to accommodate this number of students properly in this building. The Department of Chemistry needs all of this building and even then the present number of students would not have any too much room. We should have a new building for physics and electrical engineering. The Electrical Department would develop rapidly if an opportunity were given it. To do good work in physics considerable laboratory room is necessary and a building costing from fifteen to twenty thousand dollars could be very properly and profitably devoted to this department.

Bacteriological Department. Bacteriology as a useful science has forced its way to the front within the last few years. It promises to be particularly helpful to the farmers, and should in the future have an important place in our curriculum. Dairying, live stock, domestic economy, and much other work in the College depends largely on bacteriology. Four years ago we began this work and assigned rooms for it in the veterinary building. It has far outgrown these rooms, and must have a new habitation soon. The Veterinary Department needs the entire building and should have it. There can be some very useful experimental work carried on in connection with the Bacteriological Department, and to house it properly we should have a separate building costing, with the proper furnishings, about $15,000.

Our botanical building is over-crowded and should have an addition. Our Agricultural Department should have a fine agricultural building. Ohio has an agricultural building costing $100,000; Illinois has an agricultural building costing $150,000; and Wisconsin this year received $150,000 for the erection of such a building.

FACULTY.

At the close of last year Mr. Harry E. Smith, who had been a very faithful and efficient employe of the College for four years, as instructor in mechanical engineering, resigned to take up practical work. Prof. Alexander Moseley, who had been assistant professor in mechanical engineering for one year, resigned to accept a similar position in Lewis

Institute, Chicago. Prof. Hugo Diemer, a graduate of the Ohio University, and who at the time held the chair of professor of mechanical engineering in the A. & M. College of North Carolina, was called to the position vacated by Prof. Moseley, and Mr. Herman W. Reynolds, a graduate of the University of Pennsylvania, was elected instructor in mechanical engineering to fill the position made vacant by the resignation of Mr. Smith.

At the end of the fall term Mr. W. O. Beal, who had filled the position of instructor in mathematics very acceptably for two years, resigned to pursue graduate work in the Chicago University. This department was also given an additional instructor. Mr. Leslie L. Locke, a graduate of Grove City College, Pa., and also State College, Pa., and Alfred H. Parrott, a graduate of the University of Kansas, were elected instructors in mathematics. Mr. John Michels, a graduate of the University of Wisconsin, was elected instructor in dairying; Miss Sarah B. S. Avery, instructor in calisthenics; Miss Carrie Alberta Lyford, B. S., instructor in cookery; Mr. S. F. Edwards, B. S., instructor in bacteriology, and Mr. W. T. Shaw, B. S., instructor in zoology. A department of bacteriology was organized and Prof. C. E. Marshall, who had, during the past four years, been the bacteriologist of the experiment station and also instructor in bacteriology, was placed in charge.

Commencement exercises this year were held from the 16th to the 21st of June. The baccalaureate sermon was given by the Rev. David R. Breed, D. D., professor of Sacred Rhetoric in the Western Theological Seminary, Allegheny, Pa. The commencement address was delivered by Prof. J. B. Johnson, C. E., of the Wisconsin University. The degree of Bachelor of Science was conferred upon the following:

J. Guy Aldrich.
Franklin A. Bach.
William J. Bailey.
Hugh P. Baker.
Roy L. Brown.
George E. Chadsey.
John F. Coats.
Arthur J. Cook.
Harry J. Eustace.
Alice M. Gunn.
Gustave Gutekunst.
Celia A. Harrison.
Arthur H. Hayes.
Clare W. Haven.
George C. Humphrey.
Mark L. Ireland.
Don B. Jewell.
Charles W. Kaylor.
Samuel J. Kennedy.
Mary S. Knaggs.
Ralph M. Lickly.
L. Bayard Littell.
Charles A. McCue.
Newell A. McCune.
Robert S. Northrop.
Roy M. Norton.
Fleta Paddock.
Fred L. Radford.
Charles P. Reed.
George Severance.
Vernon M. Shoesmith.
J. Hackley Skinner.
John B. Stewart.
Horace T. Thomas.
Gordon E. Tower.
Walter W. Wells.
George D. White.
Roswell A. Whitney.
Vesta Woodbury.

The degree of Master of Science, in course, was conferred upon Dick J. Crosby, '93, and W. T. Shaw, 99, University of Minnesota.

The following is a summary of students in attendance during the year:

Summary.	Sugar beet.	Cheese.	Live stock.	Creamery	Fruit.	Cooking.	Agricultural.	Mechanical.	Women's.	Totals.
Post-graduates							5		3	8
Class of '01							27	13	6	46
Class of '02							36	39	13	88
Class of '03							61	71	16	148
Class of '04							76	54	61	191
Sub-freshmen								59		59
Special students							6	5	20	31
Special short course students	19	11	21	24	4	12	79		12	91
Totals							290	241	131	662
Deduct names repeated										10
Final total										652

Class entering September, 1900.

	Male.	Female	Total.
Number entering	180	70	250
	yrs. mo.	yrs. mo.	
Average age	19 1¼	20 ½	
Median age	19 1	19 ½	
SCHOOLS PREVIOUSLY ATTENDED:			
High school	130	42	172
District	22	15	37
College	12	4	16
Private	14	5	19
Not given	2	....	2
ENTERED FRESHMAN CLASS ON:			
High school diploma	47	23	70
Teacher's certificate	9	7	16
Standings from other colleges	6	3	9
Examinations	74	17	91
Age	25	6	31
Eighth grade diploma	15	11	26
SUPPORT WHILE HERE:			
Father	91	46	137
Self	61	13	74
Father and self	15	....	15
Mother	11	3	14
Not given	2	4	6
OCCUPATION OF FATHER:			
Farmer	71	36	107
Mechanic	16	3	19
Doctor	4	3	7
Dentist	....	1	1
Veterinary	1	....	1
Lawyer	5	....	5
Clerk	3	1	4
Real estate	5	....	5
Lumber	5	1	6
Minister	1	2	3
Merchant	9	2	11
Manufacturer	9	....	9
Traveling man	3	2	5
Architect	....	1	1
Electrical engineer	1	....	1
Civil engineer	5	1	6
Commission man	2	1	3
Bookkeeper	1	2	3
Retired army officer	1	....	1
College professor	1	3	4
Contractor	3	....	3
School teacher	1	1	2
Hotel keeper	2	2	4
Banker	1	....	1
Deceased	10	1	11
Miscellaneous	16	1	17
Not given	4	6	10
PROPOSED OCCUPATION AFTER LEAVING COLLEGE:			
Farming	29	....	29
Mechanical engineering	31	....	31
Electrical engineering	12	....	12
Mechanics	15	....	15
Civil engineering	14	....	14
Mining engineering	2	....	2
Architect	1	....	1
Chemist	5	....	5
Teaching	7	15	22
Physician	1	....	1
Law	4	....	4
Gardening	1	....	1
Dressmaking	....	1	1
Millinery	....	1	1
Housekeeper	....	3	3
Merchant	2	....	2
Manufacturer	3	....	3
Miscellaneous	9	....	9
Not fully decided	25	26	51
Not given	17	23	40

Church membership.

	Preference but not membership.	Membership.
Methodist Episcopal	22	26
Congregational	14	33
Presbyterian	14	19
Baptist	9	17
Episcopal	9	3
Lutheran	3	1
Catholic	5	2
Friends	1	....
Church of Christ	2	1
United Brethren	1	1
Universalist	1	3
Unitarian	....	2
Christian Scientist	....	2
Total	80	85

Counties represented in the entering class.

Alger	1	Mecosta	1
Allegan	4	Midland	3
Alpena	1	Menominee	1
Antrim	1	Missaukee	1
Barry	4	Monroe	1
Bay	3	Montcalm	1
Berrien	3	Muskegon	4
Branch	2	Montmorency	1
Calhoun	2	Newaygo	2
Cass	1	Oakland	11
Cheboygan	2	Oceana	2
Clinton	4	Osceola	1
Crawford	1	Ottawa	1
Emmet	1	Sanilac	2
Genesee	8	Shiawassee	3
Gladwin	1	Saginaw	11
Gogebic	1	St. Clair	1
Gratiot	1	St. Joseph	2
Grand Traverse	1	Tuscola	2
Hillsdale	4		
		Washtenaw	3
Huron	3	Wayne	12
Ingham	51	Wexford	3
Ionia	4		
Jackson	8	OTHER STATES AND COUNTRIES REPRESENTED.	
Kalamazoo	4		
Kent	12	Ireland	1
Lapeer	4	Quebec	1
Leelanau	1	California	1
Lenawee	4	Illinois	5
Livingston	8	Massachusetts	1
Macomb	7	New York	2
Manistee	4	Ohio	2
Marquette	1	Pennsylvania	1
Mason	4	Puerto Rico	1

For further information concerning the work of the college you are respectfully referred to the several department reports in the following pages.

Respectfully submitted,

J. L. SNYDER,
President.

AGRICULTURAL COLLEGE, MICH,,
June 30, 1901.

REPORT OF THE DEPARTMENT OF PRACTICAL AGRICULTURE.

To the President:

SIR—I have the honor to submit the following report of the Department of Practical Agriculture for the year ending June 30, 1901.

But one change has been made during the current year in the teaching force of this department. Mr. J. J. Ferguson was made instructor in animal husbandry and Mr. John Michels, a graduate of the University of Wisconsin, was elected to the position of assistant instructor in dairying.

Graduates from the agricultural course continue to be in demand as instructors in agriculture or as experimentalists at experiment stations. This being true it has been thought advisable to make it possible for students having such work in mind to elect advanced work along agricultural lines.

We are pleased to state, and we believe it can be said without fear of successful contradiction, that there never was a time within the past fifteen years' history of the institution when agriculture and agricultural instruction have received so large a share of the agricultural student's thought and interest as now. Ten years ago it was no uncommon thing to hear groups of students not only ridiculing students who took a lively interest in their agricultural work, but instructors and the information they conveyed to the student. It is a source of pleasure to all friends of the college and agricultural education in general that this change of sentiment has taken place. Personally we believe it a healthy atmosphere for the boy or young man of the farm to breathe for four or more years.

In our last report we said "agricultural instruction is in a transitional stage." What was true one year ago is more true today. A year has only shown the greater possibilities. In that time it has been found that more interests and industries of the farm are capable of being taught in class-room, laboratory, barn and field. To see that none of these growing interests suffer, growth of the department is necessary.

In our judgment the two phases of agricultural instruction most neglected at our institution at present are dairying and farm crops. We cannot give more attention to these subjects without more time. Those best informed know that the curriculum of the agricultural course is already crowded. It seems then inevitable that within the near future our agricultural students should be better prepared before taking up a college course in agriculture.

There certainly should be provision made for the agricultural student who wishes to take up station or agricultural college work after graduation to pursue the study of modern languages and have such work credited. However desirable it may be for the college to graduate men thoroughly equipped along practical agricultural lines it is not, in the mind of the writer, foreign to our work to train instructors in agriculture and experimentalists.

During the past year it has been the effort of the department to bring students into closer touch with practical farm life and typical progressive farmers. To this end several prominent stock breeders and farmers have been invited to address our students and quite a number of our best farms in the State have been visited. We thoroughly believe that such trips and the contact of the student with the best that is in practical agriculture is of incalculable benefit to the student. We hope to develop this line of work in the future.

The department has helped to organize and maintain an annual students' judging contest which promises to be of great value to the student.

The Michigan Agricultural College was represented by a creditable exhibit of live stock at the Chicago International Exposition of 1900. Some fine specimens of sheep have been added to the college flocks. We believe that we are not optimistic when we state that the college stock and farm were never in better condition than at the present time.

It is indeed an invigorating experience to a farmer, who loves so much to see a "good stand" of clover, to wander along the college lane and find that every field on the left side of the lane is beautifully seeded to clover. Only in one field, number 13, was any timothy sown with the clover.

In our opinion such clover is only possible on fertile virgin soil or where an abundance of barnyard manure is regularly applied. It is no secret that such a system of farming brings success. The Farm Department is doing what it can to emphasize this fact among students and farmers by the most potent factor possible—an object lesson.

The present agricultural laboratory is in no way adequate to the needs of the department. We hope in the near future to see a suitable building which will in every way meet the wants of the department and represent the importance of agriculture in Michigan and of agricultural education at our college.

Respectfully submitted,
HERBERT W. MUMFORD.
Professor of Agriculture and Superintendent College Farm.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1901.

REPORT OF THE DEPARTMENT OF HORTICULTURE AND LANDSCAPE GARDENING.

To the President:

SIR—Although there has been no increase in the working force there has been a considerable increase in the work that has fallen to the department. This has been due to the larger number of elective subjects that have been taught by the department and the increase in the number of students, as well as to a considerable increase in the amount of work performed upon the grounds.

As the curriculum is now arranged, the required work of the students in this department begins with the spring term of the sophomore year. It continues for two terms, occupying one hour in the lecture room and two and one-half hours of laboratory work each day. During the remaining five terms of the course the work is elective, but for the agricultural students the election lies only between agriculture and horticulture. The class room and much of the laboratory instruction has been under the charge of Prof. U. P. Hedrick, who presents the following report of his work for the past year:

"During the fall term the following classes, the number of students in each being given, were under my charge: Agricultural juniors in pomology, 34; women juniors in landscape gardening and floriculture, 15; women seniors in floriculture, taken as an elective, 10. The agricultural seniors, 14 in number, who had elected horticulture the year previous, were for this year tranferred to the Botanical Department in order that they might take a much needed course in physiological botany. Two hours per day were spent in laboratory work with the juniors in pomology.

"The class-room work during the winter term was much lighter than in the one preceding, consisting of but two regular classes, namely: Evolution of garden plants, taken by 14 seniors, and floriculture and vegetable forcing, a junior study taken by a class of 18. During this term the writer addressed seven farmers' institutes on horticultural subjects.

"My work in the spring term was as follows: A class of 63 sophomores, men and women, in vegetable gardening; a class of 15 juniors in spraying of plants, twice a week; a class of sophomore women and junior men in landscape gardening, three times a week; a class of 10 juniors in thesis work two hours per day; and seven seniors in thesis work at such hours as could be found."

As in previous years, the work in pomology consisted of lectures and laboratory work. A section of the agricultural juniors spent two hours each day in studying the characteristics of the different species of fruit in common cultivation and in becoming familiar with the leading varieties of each. Others were engaged in the routine work of the greenhouse, grounds, orchards and vegetable garden. In the winter term Mr. Gunson had charge of the laboratory work in the greenhouses of the regular agricultural and women students electing floriculture, as well as of a number of special students in horticulture. The laboratory work of the sophomores in the spring term consisted of practical work in fruit culture, vegetable and landscape gardening. In fruit culture, or pomology, it included grafting, pruning fruits of all kinds, planting and transplanting, including the planting of root grafts and seedlings for budding in the nursery, and the digging of nursery trees. In the vegetable garden they took up the sowing of seeds in hot-beds and forcing houses, transplanting, sowing the different crops by hand and with seed drills in the open ground, and the general work of the season. In landscape gardening the work consisted of the pruning of shrubbery, laying out and planting of borders and beds with shrubbery, herbaceous perennials and annuals, caring for walks and drives, etc. This work was performed under the direction of the writer, Mr. M. L. Dean, assistant in the experiment station, and Mr. H. Sherman, an employe of the department. As the work required careful supervision, it became necessary to make use of the assistance of several upper classmen who are making a specialty of horticulture, as student instructors. Mr. R. S. Northrop, '01, took charge of the work of grafting and the care of nursery stock; Mr. Geo. E. Chadsey, '01, had the oversight of the pruning of the shrubbery and much of the landscape gardening work; Mr. D. B. Jewell, '01, aided Mr. Dean in carrying on the instruction in the vegetable garden and forcing house; Mr. E. R. Bennett, '02, took charge for several weeks of the pruning of orchard trees. All of the instructors showed excellent judgment and good executive ability in conducting the work, and the students displayed much interest in it.

The juniors electing horticulture were allowed to choose the line of work they would take up. Several elected floriculture under Mr. Gunson, but a majority took up an interesting line of experiments under Prof. Hedrick.

SPECIAL STUDENTS IN HORTICULTURE.

Although the department has offered but one special six weeks' course during the past year, that in fruit culture, a number of students for special work in floriculture presented themselves and were assigned to the regular classes for this instruction.

To the short course students in pomology the lectures and laboratory instruction was given by the writer, while Prof. Hedrick gave them one lecture each day on the chemistry of plants, soil and fertilizers. Prof. Wheeler had charge of the work in botany and Prof. Pettit of the instruction in entomology.

THE GROUNDS.

As noted above there was a considerable increase in the work done upon the grounds and about the buildings. During the summer trenches were opened up for sewer and water pipes to supply "Oakwood," the addition now being opened at the north of the college grounds. This work was all paid for by the owners of "Oakwood." Other trenches were opened for a water pipe to the women's building, for a steam pipe to the horticultural laboratory and for steam, water and sewer pipes to the new dairy building. As the women's building and dairy building approached completion, a large amount of rubbish of all kinds was removed, and the ground about them was graded. In order to bring the grade line up to the water-table, it became necessary to haul several hundred loads of soil, which took up the extra time of the teams during the fall and for a number of days in the spring. The soil about the dairy building is a light sand and this was covered to the depth of four inches with surface soil. The lawn was then seeded, shade trees and evergreens planted and shrubbery and flowering plants set out. Several other borders were prepared and planted and a considerable amount of grading and sodding was done. As the Norway spruces about the grounds had in many places become so large as to cut off the view, it was thought best to remove a part of them and some twenty were dug out by the roots. Many of them were very fine specimens, planted forty years ago, and fifty to seventy feet high. In addition to the changes above mentioned, it has required a large amount of work to keep up the drives, lawns, shrubbery and flower beds, but it has been done without any increase in the working force. During the late fall the new athletic field was graded and a quarter mile bicycle track with embankments at the curves was laid out, the work being done by the teams and regular employes of the department.

Late in the fall, an artificial stone walk to the new women's building was constructed, connecting with the main walk near the library at one end, and with the same walk in front of Howard Terrace at the other. The grounds are now fairly supplied with cement walks, but there are at least four places where short lengths could be used to advantage, (1) from the dairy building to the library, (2) along the east side of Abbot hall to the armory, (3) north from the east ward of Wells hall, (4) east from College hall to connect with the walk to the library.

GREENHOUSES.

The college greenhouses have been under the charge of Mr. Thomas Gunson, whose title has been changed during the year to "Instructor in floriculture." In addition to the care of the houses he has taken charge of the practical instruction in floriculture, and has given some time to attending the sessions of the State Horticultural Society and Farmers' Institutes.

The iron frame houses constructed in 1892 are in good condition except that the woodwork needs painting, but the remaining wing of the house should be rebuilt at once. We also need larger accommodations for the laboratory work of the students, which can be free from the intrusion of visitors during class hours. In order that they may properly serve for practical work of the students in commercial floriculture we should have houses for the growing of roses, carnations and the propagating of plants.

During the session of the legislature, flowers were furnished for the presiding officers' desks and for various functions at the capitol. The plants and flowers have also been in great demand for receptions and other gatherings at the college.

VEGETABLE GARDEN AND ORCHARDS.

Aside from their value for experimental purposes, the orchards and gardens have served for purposes of illustration and for the practice work of the students. The work thus furnished has, for the most part, been paid for, and has thus aided about 125 students in paying their college expenses. The products have been harvested by the students and sold to the boarding clubs and members of the faculty.

Respectfully submitted.

L. R. TAFT.

Professor of Horticulture and Landscape Gardening.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1901.

REPORT OF CHEMICAL DEPARTMENT.

President Snyder:

The annual report of the Chemical Department for the year closing June 30, 1901, is herewith submitted. The year has been a very successful one in this department, the number of students larger than in any year of the history of the college, and the interest of all the classes has been sustained in the various lines of work. Many of the classes are so large that it is necessary to divide them in order to provide room for laboratory work. The need of more room for individual work in the laboratory becomes more pressing with each succeeding year.

The total number of students in the Chemical Department this year, counting them by terms is 524. Many of these students appear more than once in this number as they pass successively in the classes of the college year.

The following general statement will indicate the kind of instruction given in classes and order of sequence.

During the year instruction has been given in elementary chemistry to the students in the sophomore class in the agricultural course and to the students of the same class in the women's course, for one term. The instruction in both classes included five lectures a week and two hours of laboratory work.

The same students in these two courses devoted one term (two hours a day) to analytical chemistry, and the following term to organic chemistry, with laboratory practice.

In the mechanical course, the students spent six hours a week in mineralogy, or the special study of the metals as related to mechanics.

During the winter term the regular course of lectures was given to the junior agriculturals on agricultural chemistry.

In the spring term a course of lectures on meteorology was given to the senior agriculturals who elected that study.

During the winter and spring terms a class of young men was organized who wished to specially prepare themselves for chemical work in the growing beet sugar industry of our State.

NUMBER OF STUDENTS BY CLASSES, AND HOURS OF CLASS WORK IN EACH TERM.

Term	Classes	Students.	Hours.
Fall term	General chemistry Organic chemistry	183	56
Winter term	General chemistry Analytical chemistry Agricultural chemistry	238	72
Spring term	Mineralogy Meteorology Sugar beets	140	54

OUTSIDE WORK.

The usual amount of work of a miscellaneous character has come to the chemical laboratory, analysis of marls and coals, the examination of numerous specimens of materials that strike the eye of the observer and differ from the usual soil materials. Among these a large number of decomposed granite, showing the glittering particles of mica so easily mistaken for gold. The laboratory seems to be a bureau of general information for the public.

A NEW DOOR OF USEFULNESS.

The Chemical Department is ever desirous of finding new ways by which it may benefit the farming class. A new door of usefulness opens before it in the valuation of commercial cattle foods. It is not necessary that all such materials should be analyzed. For a large body of such materials the good judgment of the cattle feeder is sufficient. The food value of whole grains and the meals produced from them is evident to every stock feeder. The judgment is not so simple when the residues and by-products of such grains and seeds are offered in the form of hulls, brans and mixed feeds. The miller and manufacturer usually removes the most valuable and costly material, and the residue is often deficient in protein and fat, but contains an excess of carbonaceous material of a cheaper grade for stock feeding. This is not always the case, but is true as a general rule.

The true value of such by-products cannot be determined by mere inspection; they vary widely in value and availability; they are not accurately measured by the price, for two samples of hulls of similar appearance demand the same price, yet differ by fifty per cent in real value. In such case the chemist may render the stockman valuable assistance.

The increasing consumption of such by-products of mills and factories and the introduction of other stock feeds for which extraordinary value is claimed, make it desirable that the stock feeder secure information which may assist him in determining their real value. In many states the analysis of such products is systematically done and the composition is branded upon every package offered for sale. In such way the stock feeder has some assurance of the value of the material he buys.

At the meeting of the Michigan Dairymen's Association last winter the subject was discussed and the importance of such analysis was recognized. The plan of gathering specimens of stock feeds, having them analyzed, and the results given to the public in Bulletins in the same way as commercial fertilizers have been treated was approved and resolutions to that effect were passed. A bill for this purpose was introduced in the last legislature but failed to pass. There is little doubt that the stock and dairy interests of the State will demand legislation to protect their interests in this line.

Respectfully submitted,
R. C. KEDZIE,
Professor of Chemistry.
F. S. KEDZIE,
Adjunct Professor of Chemistry.

Agricultural College, Mich.,
June 30, 1901.

REPORT OF THE MECHANICAL DEPARTMENT.

To the President:

Sir—I have the honor of submitting the following report of the work done in the Mechanical Department during the year ending June 30, 1901.

The work in the class rooms, drawing rooms, etc., has been conducted as follows:

FALL TERM.

Seniors.—Thermodynamics by Prof. Weil. Graphical Statics of Mechanism, Elementary Kinematics, and Steam Engine Design by Prof. Diemer. Experimental Laboratory by Prof. Weil and Mr. Reynolds. Shop Practice by Mr. Leonard.

Juniors.—Machine Design by Mr. Reynolds. Metallurgy by Prof. Weil. Shop Practice by Mr. Leonard.

Sophomores.—Shop Methods by Mr. Leonard. Shop Practice by Messrs. Leonard, Theadore, and Baker.

Freshmen.—Shop Practice by Mr. Bradford and Mr. Baker.

Sub-Freshmen.—Visits of Inspection by Mr. Reynolds.

WINTER TERM.

Seniors.—Advanced Kinematics by Prof. Weil. Steam Engineering Laboratory by Prof. Weil and Mr. Reynolds. Advanced Machine Design by Mr. Leonard.

Juniors.—Machine Design, Steam Engine Design, and Valve Gears by Prof. Diemer. Boilers by Prof. Weil. Shop Practice by Mr. Leonard and Mr. Theadore.

Sophomores.—Elements of Machine Design by Mr. Reynolds. Shop Practice by Messrs. Leonard, Theadore, and Baker.

Freshmen.—Shop Practice by Mr. Bradford and Mr. Baker.

Agricultural Freshmen.—Shop Practice by Messrs. Theadore, Bradford, and Baker.

SPRING TERM.

Seniors.—Engineering Practice and Thesis Work by Prof. Weil. Original Design by Mr. Leonard.

Juniors.—Strength of Materials and Testing Materials of Engineering by Prof. Diemer. Shop Practice by Mr. Leonard and Mr. Theadore.

Sophomores.—Elements of Machine Design and Elements of Steam Engine by Mr. Reynolds. Shop Practice by Messrs. Leonard, Theadore, and Baker.

Freshmen.—Shop Practice by Mr. Bradford and Mr. Baker.

At the close of the College year, Professor A. W. Moseley resigned his position as assistant professor of mechanical engineering to accept an assistant professorship—at a considerable advance in salary—at the Lewis Institute, Chicago. Mr. Moseley is a man of experience in engineering—both in practice and teaching—and he rendered this department, during his brief connection with same, very efficient service. Mr. H. E. Smith, instructor in mechanical engineering, also severed his connection with this department last year; he accepted a position in practical engineering work. During a service extending over four years in the department, Mr. Smith showed himself to be a conscientious, thorough, and efficient worker. The positions vacated by the above named men were filled by the election of Mr. Hugo Diemer and Mr. Hermann W. Reynolds to the assistant professorship and instructorship, respectively.

The large attendance, during the year, necessitated the employment of Mr. Theadore to give instruction in the machine shop as well as in the forge shop, and of Mr. E. J. Gunnison as assistant in the foundry and wood shop. Mr. G. B. Fuller assisted in the shops and experimental laboratory during a portion of the fall term.

The crowded condition of our shops permits of spending but a comparatively small amount of time in machine building. During the year a 10-inch wood lathe has been completed, and considerable work done on a 16-inch engine lathe now under construction. In this connection I would report that the department now has complete designs and working drawings for a number of machine tools, including a milling machine, drill press, engine lathe, and shaper. The drawings were made by our senior classes and under the immediate supervision of Mr. Leonard.

During the year the usual amount of repair work has been done, and our shops will run during a greater part of the summer vacation mainly for the purpose of doing similar work.

Among the more important apparatus added to this department, during the year, I will mention the following: No. 3 Oliver wood trimmer; Leland, Faulconer & Norton universal trimmer; two steam engine indicators; Fairbanks cement testing machine; Corliss valve model; tachometer; Carpenter separating calorimeter; throttling calorimeter; Yankee drill grinder; mercury pyrometer; three 14-inch x 6-foot standard lathes, built by the American Tool Works Company, Cincinnati, Ohio,—the tools last named being a very valuable addition to our equipment. A Parr calorimeter, for testing heat of combustion of fuels, has been purchased, jointly with the Chemical Department.

The department has recently made and installed one hundred lockers, in the wood shop; these lockers are in fourteen portable cases, each case carrying eight lockers, and are a great convenience to students, as well as facilitating work in the shop. We have, also, made and installed a case for 150 small drawing boards and placed 90 such boards in the wood shop,—the boards to be used in connection with pattern sketches.

In consequence of the continued increased attendance in this department—an increase of 112 per cent during the past ten years—there is great need, for the proper handling of our students, that the department be given more floor space. I desire to again urge the consideration of an additional building for carrying on engineering and drawing-room work. In fact our class room and drawing rooms are so crowded at times, that not only is the work carried on at a disadvantage, but the conditions are such as to impair the health of the students. Further I would suggest that until such time as we can provide proper accommodations for students the number of students in the mechanical course should be limited to 150 in all.

A very satisfactory interest has been displayed in our work, during the past year, by engineering concerns and some valuable apparatus has been loaned to the department for experimental purposes; among such apparatus I may mention a wind mill from the Maud S Wind Mill & Pump Company, fan blowers from the Buffalo Forge Company and the American Blower Company of Detroit, and a 12 H. P. gasoline engine from the Lansing Boiler & Engine Works.

During the summer and fall months of 1900 the writer did considerable work as consulting engineer for the College in connection with the heating of new buildings, etc.

Respectfully submitted,
CHAS. L. WEIL,
Professor of Mechanical Engineering.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1901.

REPORT OF THE DEPARTMENT OF BOTANY AND FORESTRY.

To the President:

Herewith I have the honor to hand you my report for the year closing June 30, 1901.

During the year students have received instruction in this department as shown in the following table:

Class.	Subject.	Term.	Hours per week.	No. of students enrolled.
Senior	Plant physiology	Fall	5	13
Junior	Parasitic fungi	Fall	9	23
"	Grasses	Winter, 4 weeks	5	21
"	Weeds	Winter, 4 weeks	5	21
"	Forestry	Winter, 36 lessons	3	28
"	Plant ecology	Spring, 30 lessons	3	25
"	Trees and shrubs	25 lessons	2½	26
Sophomore (men)	Plant histology	Winter	9	51
" (women)	Plant histology	Spring	7	12
" (women)	Trees and shrubs	Spring	2½	16
Freshmen	Begin botany	Fall	7½	134
"	Systematic botany	Winter	2	101
Special course in horticulture	Botany	Winter, 6 weeks	7½	7
Special course in sugar beets	Botany	Spring	2	15
Total				493

The teaching force of the department remains unchanged, while the number of students is twenty-nine more than last year. There has been a larger proportion of laboratory work than ever before, and more of other kinds of work than ever before. As the number of students in the College increases, there is more correspondence in answer to hosts of inquiries regarding weeds, grasses, fungi, forestry and miscellaneous things in very great variety. There are more calls on the members of the teaching force for lectures outside the College, e. g., Longyear on mushrooms, twice in Detroit, Professor Wheeler at the meeting of the State Pioneer Society, myself at a meeting of four societies held in New York city, and one held at Rochester, New York, one high school commencement, one at the round-up institute.

Answering questions for the Michigan Farmer and articles for other journals demand time.

THE HERBARIUM.

The additions for the year past have been as follows:

Seed plants, ferns and their allies.

H. C. Skeels, plants from northern Illinois	144
H. N. Hornbeck, cacti, etc	7
L. H. Dewey, for U. S. Dept. Agriculture, cultivated varieties of hemp and cotton	13
Rev. F. P. Daniels, Michigan and Western United States	64
Elias Nelson, species of Antennaria of United States	47
B. L. Robinson, from herbarium of Harvard University	146
A. Phelps Wyman, collected to order in the Arnold Arboretum	1,500
Sam'l Tracy, the coast of Florida and vicinity	617
C. G. Pringle, Mexican plants for 1900	190
C. D. McLouth, plants from Muskegon	136
Wheeler and McLouth, plants from Muskegon	121
C. F. Wheeler, plants collected at Crystal lake, Montcalm county	181
C. F. Wheeler, Pine lake and Park lake	57
C. F. Wheeler, Chandlers	50
C. F. Wheeler, plants collected at Chatham	296
C. F. Wheeler, plants collected near the College	326
W. J. Beal, hawthorns	20
L. J. Cole, plants from Alaska	144
B. Barlow, plants collected in Marquette county	182
L. J. Cole, plants collected at Biltmore, N. C	80
L. J. Cole, plants collected at Grand Rapids and Lansing	300
	4,101

FUNGI.

E. S. Salmon, foreign Erysiphæ		22
Arthur & Holway, Uredineæ, 35a-44b, Fasc. III		28
B. O. Longyear, saprophytic at M. A. C., Jackson county, Montcalm county		116
C. F. Wheeler, saprophytic at M. A. C., 90. C. F. Wheeler, parasitic, 267	Chatham, Mich.	357
G. H. Hicks	parasitic, 2,411 saprophytic, 475	2,886
A very large proportion of the Hicks collections were made in Michigan, and of these M. A. C. and vicinity were well represented. There were some collected by Ellis and Everhart, some by Kellerman and Swingle in Kansas, some by Kellerman in Kentucky, some by J. J. Davis, Wisconsin, some by E. W. D. Holway, Iowa, some by H. S. Jennings in Texas.		
		3,409

ALGÆ.

Collins, Holden and Setchel, Fascicle B	25
Collins, Holden and Setchel, Fascicle 15	50
Collins, Holden and Setchel, Fascicle 16	50
	125
Total additions for the year closing June 30, 1901	7,635

GENERAL SUMMARY OF PLANTS IN THE HERBARIUM.

Seed-plants (Spermatophyta)	60,627
Ferns and their allies (Pteridophyta)	1,142
Mosses and Liverworts	1,887
Lichens	1,135
Fungi	12,953
Algæ	1,395
Total number in the herbariums	79,139

THE BOTANIC GARDEN.

The area of two acres in extent passing by this name is situated along the valley and on both banks of the brook. There are not far from 2,000 species of plants cultivated, a considerable number of which are shrubs and perennial herbs. The garden has been maintained in much the same condition that it was last year and year before. For notes of the plan and other items, any one interested is referred to several of the previous annual reports.

THE ARBORETUM AND THE FOREST AT THE COLLEGE.

During July of 1900, a severe wind from the west blew down large numbers of forest trees, especially in the field just south of the river, and in the field lying between the two railroads that cross the College farm.

An attempt had recently been made to leave standing in these lots the straightest and thriftiest trees, and in the western portion of these lots but few other trees remained, save the younger growth. The disappearance of these trees leaves numerous large open places. The remaining tall trees farther to the east are now more certain to fall soon or to be destroyed by exposure to sun and wind.

Most of this felled timber was cut last winter, making stove wood, 500 cords; 3-foot wood, 206 cords, besides a few small mill logs.

No trees were planted.

The small lot of 6.6 acres east of the north and south road up the river was partially planted to white pines in the spring of 1896. The area thus planted consisted of 2.2 acres. Owing to the uneven quality of the soil, a few trees have made an uneven growth. The original plan was to cultivate the pines for a few years and then plant the area between the wide rows of pines (10x12 feet) to box elders that they might shade the ground sufficiently to prevent the grass from damaging the pines and thus make further cultivation unnecessary. It is now the intention to set box elders in the spring of 1902.

DONATIONS.

From W. Paddock, Geneva, N. Y.: 3 trees inoculated with Sphæropsis.

From Ernest S. Salmon, Chester House, Kew, England: 22 species of Erysiphæ.

This list of donations does not include a large number of separates or pamphlets, reports and new books for review that have been received, as most of them come under the nature of exchanges.

Again, I am under great obligations to Professor C. F. Wheeler and Instructor B. O. Longyear, for faithful services rendered.

With very best wishes, I am yours sincerely,

W. J. BEAL,
Professor of Botany and Forestry.

Agricultural College, Mich.,
June 30, 1901.

TREES AND SHRUBS

BY W. J. BEAL, PROFESSOR OF BOTANY AND FORESTRY.

In the report of the secretary of the State Board of Agriculture for 1878, there appeared a brief and popular account of the trees and some of the shrubs then growing on the grounds of the Agricultural College. One thousand "separates" were printed for the use of our students and others interested in the subject. This supply was exhausted in less than ten years. In 1887, Professor Bailey printed for use of his classes, a list of ornamental plants which are hardy in Michigan.

A period of thirteen years has wrought many changes at M. A. C. in the number and variety of trees and shrubs as well as in other respects. The scientific and the common names have been arranged alphabetically in one list, and the location of one or more trees and shrubs of each kind has been pointed out, and when the spot has been reached, the student will usually find the object plainly labeled. The nomenclature is chiefly that of "Index Kewensis,"—a work consisting of four large quartos published under the supervision of the officers of the Kew Gardens, England. Doubtless there may be errors in the list of names as here given, owing to the small size of some of the woody plants, their failure to produce flowers or fruit and for other reasons.

Those which have been long tested and found hardy and otherwise desirable for planting about a home or in public grounds have been marked with a*. As many others have been tried in places perhaps unfavorable on account of soil, elevation, exposure, or for other reasons, it may not be fair to condemn or discard all of those not starred.

Again, some have but recently been planted and have thrived for a year or more, but may soon prove undesirable, owing to failure to endure the extremes of heat, drougth or cold. Some of the small trees and any of the shrubs are liable to be removed from stations here given. For descriptions, the reader is referred to any suitable manual of Botany and to some of the best nursery catalogues of the day.

The number of species and varieties here enumerated is 619, a number which could be very easily increased five fold with good promise that most of them would prove hardy.

*Abies balsamea (L.) Mill. Balsam Fir.
Between the Union Literary Building and the greenhouse; southeast of the President's house; northwest of the Horticultural Laboratory. Usually becoming shabby after 15 to 20 years.
*Abies concolor Lindl. & Gord.
Some distance south of residence number 10.
Abies grandis Lindl.
In row 35 of the Arboretum.
*Abies nordmanniana Spach.
Some distance south of residence number 10; in the Arboretum toward the north end of row number 35; northeast of the Botanical Laboratory and east of the hedge.
Abies pectinata DC. European Silver Fir.
West of the playground; in the hollow some distance south of Howard Terrace.
*Acer campestre L. European Maple.
West of house number 2; northeast of the west entrance to the Campus.
Acer japonicum sanguineum Hort. Blood-leaved Japan Maple.
The northeast part of the Botanic Garden and south of the brook.
*Acer Negundo L. (Negundo aceroides Moench.) Box Elder. Ash-leaved Maple.
In the south part of the Arboretum; southwest of the library.
*Acer nigrum Michx. Black Maple.
*See Acer saccharum nigrum.
*Acer pennsylvanicum L. Striped Maple.
In the east row of the Arboretum; in the northeast part of the Botanic Garden.
Acer pictum rubrum Hort.
In row 45 of the Arboretum.
*Acer platanoides L. Norway Maple.
Between College Hall and the Chemical Laboratory; northwest of the Horticultural Laboratory.
*Acer platanoides dissectum Hort. Cut-leaved Norway Maple.
East of College Hall.
Acer platanoides rubrum. Hort. Red-leaved Norway Maple.
West of the Botanical Laboratory.
Acer platanoides Schwedleri Hort. Schwedler's Norway Maple.
South of Bachelor's Hall.
*Acer Pseudo-platanus L. Sycamore Maple.
South of house number 2; west of the Mechanical Laboratory.

Acer Pseudo-platanus aurea Hort. Golden Sycamore Maple.

East of College Hall.

Acer Pseudo-platanus variegatum. Hort. Variegated Sycamore Maple.

East of College Hall.

*Acer rubrum L. Red Maple.

Northeast of the "Big Stone" that was set by the class of '73; southeast of the Botanical Laboratory.

*Acer saccharinum L. (A. dasycarpum Ehrh.) Silver Maple.

South of the river opposite the President's house; north of the office of the secretary.

*Acer saccharinum laciniatum Wieri Hort. Wier's Cut-leaved Maple.

West of house number 2; southwest of house number 10.

*Acer saccharum Marsh. (A. saccharinum Wang.) Sugar Maple.

West of dwelling house number 3, a tree planted by President Abbot; in many other places.

*Acer saccharum nigrum (Mich. f.) Britton. Black Maple.

Near the hitching post by the drive south of dwelling number 5.

*Acer spicatum Lam. Mountain Maple.

In the east row of the Arboretum.

*Acer tataricum L. Tartarian Maple.

Northwest of playground; northwest of the west entrance to the Campus.

*Æsculus glabra Willd. Buckeye.

South of the south drive that is southwest of the playground near a horse chestnut.

*Æsculus Hippocastanum L. Horse Chestnut.

Between Wells Hall and the Chemical Laboratory; south of the drive, that is southwest of the playground, a buckeye near it. Hardy on clay soil.

Æsculus Hippocastanum flore pleno alba Hort. White Double-flowered Horse Chestnut.

West of the pear orchard on the hill. Hardy on clay soil.

Æsculus Hippocastanum flore pleno rubra Hort. Red Double-flowered Horse Chestnut.

West of the pear orchard on the hill. Hardy on clay soil.

Alder, see Alnus.

Alnus glutinosa (L.) Medic.

In row 34 of the Arboretum.

*Alnus glutinosa imperialis Hort. Imperial Cut-leaved Alder.

A choice small tree, southwest of the Chemical Laboratory.

Alnus incana hirsuta Hort.

East of the Woman's Building.

Alnus japonica Sieb. & Zucc. Japanese Alder.

East of the Woman's Building.

Alnus maritima (Marsh) Muhl. Sea-side Alder.

In row 46 of the Arboretum.

Alnus oregona Nutt. Red Alder.

Southeast of the west entrance to the Campus.

*Amelanchier canadensis (L.) Medic. June Berry.

With A. oligocarpa and A. rotundifolia in the northeast portion of the Botanic Garden.

*Amorpha fruticosa L.
With the Leguminosæ of the Botanic Garden; north of the office of the secretary.
Ampelopsis. See Parthenocissus.
Apple. See Pyrus.
Aralia cachemirica Decne.
Near the brook in the upper part of the Botanic Garden.
*Aralia spinosa L. Hercules Club.
Near the brook in the upper part of the Botanic Garden.
Arbor Vitæ. See Thuja.
*Arctostaphylos Uva-ursi (L.) Spreng. Bearberry.
In the sand in the north side of the Botanic Garden.
*Aristolochia Sipho L'Herit. Birthwort. Dutchman's Pipe.
South of dwelling number 10; at northeast part of the Botanic Garden.
*Aronia arbutifolia (L.) Ell. (Pyrus arbutifolia L. f.).
*Aronia nigra (Willd.) Britton, (Pyrus arbutifolia melanocarpa Hook.) (Pyrus nigra Sargent.)
Two species of Aronia to be seen in the northeast part of the Botanic Garden.
Ash, Mountain. See Sorbus.
Ash, Prickly. See Zanthoxylum.
Ash. See Fraxinus.
*Asimina triloba (L.) Dunal. (Anona triloba L.) Papaw.
Near the river east of field number 5; near the brook in the upper part of the Botanic Garden; west of the pear orchard on the hill.
Aspen. See Populus.
Azalea.
The following species are to be seen in the upper part of the Botanic Garden: A. arborescens Pursh., A. Indica L., A. nudiflora L., A. viscosa L.
Balsam. See Abies.
Basswood. See Tilia.
Bayberry. See Myrica.
Bearberry. See Arctostaphylos.
Beech, Blue. See Carpinus.
Beech. See Fagus.
Benzoin Benzoin (L.) Coulter. Spice Bush.
In the north part of the Botanic Garden near the sand bank.
*Berberis Aquifolium Pursh. (Mahonia Aquifolium Paxton.)
In the northeast part of the Botanic Garden.
Berberis Sieboldii Miq.
To be seen in the Botanic Garden near the former species.
Barberry. See Berberis.
*Berberis canadensis Pursh. American Barberry.
In the Botanic Garden.
Berberis heteropoda Schrenk.
East of the Woman's Building.
Berberis Neuberti Hort. (B. Aquifolium. B. vulgaris.).
In the Botanic Garden.
*Berberis repens L.
In the Botanic Garden.

*Berberis Thunbergi DC.
In the Botanic Garden a few rods north of the greenhouse; west of the pear orchard on the hill; southeast of the Botanical Laboratory. A very fine, small shrub.
*Berberis vulgaris L. Common Barberry.
East of the south end of College Hall; in the Botanical Garden; a hedge northeast of the Horticultural Laboratory.
*Berberis vulgaris foliis purpureis Hort. Purple-leaved Barberry.
North of the greenhouse near the Botanic Garden.
Betula alba L. White Birch.
All trees of much size died, 1892-1897.
Betula alba Japonica Hort. Japanese White Birch.
East of the Woman's Building.
*Betula alba laciniata pendula Hort. (Cut-leaved Weeping Birch.)
East of the greenhouse; west of dwelling number 10; south of Bachelor's Hall. All trees of much size died 1892-1900, probably on account of a small borer.
*Betula lenta L. Cherry Birch, Black or Sweet Birch.
In the Arboretum near the southern portion of row 24.
Betula lutea Michx. f. Yellow Birch.
In row 24 of the Arboretum.
*Betula nana L. Dwarf Birch.
Northeast of the west entrance to the Campus.
*Betula papyrifera Marsh. Canoe Birch.
Between the Chemical Laboratory and the greenhouse, planted in 1875, when a foot or two high.
Birch. See Betula.
Birthwort. See Aristolochia.
Bitternut. See Hicoria.
Bitter-sweet. See Dulcamara.
Bitter-sweet, Shrubby. See Celastrus.
Blackberry. See Rubus.
Bladdernut. See Staphylea.
Blue Beech. See Carpinus.
Blue Berry. See Vaccinium.
Box Elder. See Acer.
Buckeye. See Æsculus.
Buckthorn. See Hippophæ.
Buckhorn. See Rhamnus.
Burning Bush. See Euonymus.
Butternut. See Juglans.
Button Bush. See Cephalanthus.
Buttonwood. See Platanus.
*Caragana arborescens Lam. Siberian Pea-tree.
Southwest of, and near College Hall.
*Carpinus caroliniana Walt. (C. Americana Michx.) Blue Beech.
Near the moss house in the Botanic Garden; and near the ferns.
Cassandra. See Chamædaphne.
*Castanea dentata (Marsh) Borkh. (C. vesca Americana Michx.) American Chestnut.
In the Arboretum in rows 12, 13. Trees on the lawn in sandy soil died after the cold winter of 1898-99.

*Castanea pumila (L.) Mill. Dwarf Chestnut. Chinquapin.
In the Arboretum in row 24.
*Catalpa Bungei C. A. Mey. Bunge's Catalpa.
West of the Horticultural Laboratory; one, top grafted, west of dwelling house number 10.
*Catalpa Catalpa (L.) Karst. (C. bignonioides Walt.) Common Catalpa.
Hardy in clay soil. A damaged tree northeast of College Hall.
*Catalpa Catalpa aurea Hort. Golden-leaved Catalpa.
Near the west entrance west of the pear orchard. Hardy in clay soil.
*Catalpa hybrida Späth. Tea's Hybrid.
Northeast of College Hall.
*Catalpa Kaempferi Sieb. & Zucc. Japanese Catalpa.
Northeast of Well's Hall.
*Catalpa speciosa Warder. Hardy Catalpa.
West and near house number 11, south of the President's office.
*Ceanothus americanus L. New Jersey Tea.
In the sand at the north part of the Botanic Garden.
*Ceanothus ovatus Desf. With the next above.
A hardy native of northern Michigan.
*Cedar. See Juniperus, Thuja, Chamæcyparis.
Celastrus articulatus Thunb. Japanese Bittersweet.
On the bank near the tool house in the Botanical Garden.
*Celastrus scandens L. Shrubby Bitter-sweet.
On the bank north of the larger pond in the Botanic Garden.
*Celtis occidentalis L. Hackberry.
North of the larger pond in the Botanic Garden; west of the pear orchard.
*Celtis occidentalis pumila Hort. Dwarf Hackberry.
On the west slope west of the pear orchard.
*Cephalanthus occidentalis L. Button Bush.
South of the larger pond in the Botanic Garden; northeast of the west entrance to the Campus.
Cercidiphyllum japonicum Sieb. & Zucc. Katsura Tree.
East of the Woman's Building.
*Cercis canadensis L. Judas Tree. Red Bud.
With the Legumes in the Botanic Garden.
*Cercis chinensis Bunge. Red-bud of China and Japan.
With the Leguminosæ in the Botanic Garden; west of the pear orchard on the hill.
Chamaecyparis thyoides (L.) B. S. P. (Cupressus thyoides L.) White Cedar.
Northeast of the Botanical Laboratory.
Chamaedaphne calyculata (L.) Moench. Cassandra calyulata D. Don. Leather-leaf.
In the upper part of the Botanic Garden.
Cherry, Cornelian. See Cornus Mas.
Cherry. See Prunus.
Chestnut, Horse. See Æsculus.
Chestnut. See Castanea.
Chinquapin. See Castanea.

*Chionanthus Virginica L. Fringe-tree.
North of the greenhouse on the bank sloping toward the Botanic Garden; northwest part of the Botanic Garden; west of the Horticultural Laboratory.

*Cladrastis lutea (Michx.) Koch. (C. tinctoria Raf.), (Virgilia lutea Michx.) Yellow Wood.
North of the house of the Union Literary Society; north of the greenhouse on the bank.

Clematis.
The following are to be seen in the Botanic Garden north of the greenhouse near the ferns: C. apiifolia DC., *C. coccinea Engelm., *C. crispa L. (C. Viorna Andr.), C. graveolens Lindl., C. heracleæfolia DC., C. heracleæfolia davidiana Hort. (C. davidiana Verlot.), C. integrifolia L., *C. Jackmanni Hort., *C. M. Koster Hort., C. Lavallei Decne, C. ochroleuca Ait., *C. paniculata Thunb., C. recta L., C. Savatieri Decne, C. virginiana L., C. Vitalba L., C. viticella L.

*Clethra acuminata Michx. Sweet Pepperbush.
In the upper part of the Botanic Garden.

Clethra alnifolia L.
In the upper part of the Botanic Garden.

Coffee-tree, Kentucky. See Gymnocladus.

*Cornus florida L. Flowering Dogwood.
Northwest of the greenhouse on the bank of the brook; common in the woods north of M. A. C.; west of the Horticultural Laboratory.

Cornus Mas L. Cornelian Cherry.
Near the west entrance; south of the pond in the Botanic Garden.

Cornus Mas variegata Hort.
Near the west entrance.

*Cornus sanguinea L. Red Siberian Dogwood.
Southwest of house number 8; northeast of College Hall.

Cornus.
Besides those mentioned elsewhere, the following are to be seen southeast of the larger pond in the Botanic Garden: C. Amomum Mill. (C. sericea L.), *C. alternifolia L., C. asperfolia Michx., C. Baileyi Coult. & Evans, C. candidissima Marsh (C. paniculata L'Her.), C. circinata L'Her., *C. stolonifera Michx.

*Corylus americana Walt. Hazel-nut.
Southwest of the playground where the drive runs down the bank to the river; northeast of Wells' Hall.

Corylus Avella L. Filbert.
South of the south drive, or southwest of the playground. Not hardy; the seeds were from bushes grown at Union Springs, Cayuga county, N. Y.

*Corylus rostrata Ait. Beaked Hazel-nut.
Near the drive that passes by the entrance to the boulevard to the river flats, i. e., southeast of the President's house.

*Cotinus cotinoides (Nutt) Britton. (Rhus Cotinus T. & G.) Smoke-tree.
Southeast of the President's house; in the Botanic Garden on the bank near the ponds.

Cotoneaster acuminata Lindl.
In the upper part of the Botanic Garden.

Cotoneaster buxifolia Wall.
Northeast of the west entrance to the Campus.
Cotoneaster tomentosa Lindl. C. vulgaris Lind.
Northeast of William's Hall.
Cottonwood. See Populus.
Crab Apple. See Pyrus.
Cranberry-tree. See Viburnum Opulus.
*Cratægus oxyacantha punicia Hort. Single Scarlet Hawthorn.
Southwest of the Chemical Laboratory.
*Cratægus oxyacantha coccinea flore pleno Hort. Double-flowered Scarlet Hawthorn.
To be seen northeast of the Library.
Cratægus oxyacantha flore alba pleno Hort. Double-flowered White Hawthorn.
West of the Horticultural Laboratory.
Cratægus.
Small plants to be seen in the northeast part of the Botanic Garden: C. coccinea L., C. Crus-galli L., C. macracantha Lodd., C. mollis (T. & G.) Scheele, C. punctata Jacq., C. tomentosa L.
Crataegus punctata Jacq.
Northeast of the Ice House; on the north bank of the Botanical Garden.
Cucumber-tree. See Magnolia.
Cupressus pisifera plumosa Hort. Plumose Retinospora.
West of house number 10.
Currant. See Ribes.
*Cydonia japonica Pers. Japanese Quince. (Pyrus japonica Thunb.)
Near and northwest of house number 4; in the upper part of the Botanic Garden.
Cypress. See Taxodium.
Dewberry. See Rubus.
Diervilla sessilifolia Buckl.
North of the Library; in the upper part of the Botanic Garden.
Diervilla trifida Moench.
In the upper part of the Botanic Garden.
*Dirca palustris L. Moose-wood. Leatherwood.
Southwest of the playground and south of the drive; northeast of the west entrance to the Campus.
Dogwood. See Cornus.
Dutchman's Pipe. See Aristolochia.
Elæagnus angustifolia L.
West of the Horticultural Laboratory.
*Elæagnus multiflora Thunb. (E. longipes A. Gray.)
In the north part of the Botanic Garden on the bank.
Elæagnus songorica Fisch.
To be seen.
*Elæagnus umbellata Thunb. Japanese Olive.
In the north side of the Botanic Garden.
Elder. See Sambucus.
Elm. See Ulmus.
*Euonymus alatus Thunb. Japanese Spindle Tree.
Near the toolhouse in the Botanic Garden.

*Euonymus Americana L. Burning Bush.
Near the toolhouse in the Botanic Garden.
*Euonymus atropurpurens Jacq. Wahoo. Burning Brush.
West of the toolhouse in the Botanic Garden.
*Euonymus europæus L. Spindle Tree.
North of the Library.
Euonymus nanus MB.
Near the tool house in the Botanic Garden; northeast of the Library.
Euonymus obovatus Nutt. E. nana MB., E. radicans Sieb. & Zucc.
With others near the tool house in the Botanic Garden.
*Exochorda grandiflora Lindl.
On the slope west of the pear orchard on the hill; near the brook in the upper part of the Botanic Garden.
*Fagus american sweet. (F. ferruginea Ait.) Beech.
East of Abbot Hall; a fine tree south of the Hospital; two west of the brook below the Botanic Garden.
*Fagus sylvatica L.
In north end of row 35 of the Arboretum.
Fir. See Pinus or Abies.
*Forsythia suspensa Vahl. (F. Fortunei Hort.), (F. Sieboldi Dipp.)
West of the pear orchard on the hill; in the northwest part of the Botanic Garden.
*Forsythia viridissima Lindl. Golden Bell.
West of the pear orchard on the hill; northwest part of the Botanic Garden.
*Fraxinus american L. White Ash.
Southwest of dwelling house number 5; west of the hedge on the hill that is west of the President's house.
*Fraxinus americana acubaefolia Hort. Golden Spotted-leaved Ash.
West of the pear orchard on the hill; north of the greenhouse and east of the Chemical Laboratory; west of the boiler house.
Fraxinus excelsior L. European Ash.
West of the pear orchard on the hill.
*Fraxinus nigra Marsh. (F. sambucifolia Lam.) Black Ash.
Southeast of dwelling house number 4; west of pear orchard on the hill; between the Botanic Garden and the greenhouse.
*Fraxinus pennsylvanica Marsh. (F. pubescens Lam.) Red Ash.
Row 26 of the Botanic Garden.
*Fraxinus pennsylvanica lanceolata Sargent. (F. viridis Michx.(Green Ash.
In the east part of the Arboretum.
*Fraxinus quadrangulata Michx. Blue Ash.
West of the pear orchard on the hill; west end of the forest that is east of number 7.
Gale, Sweet. See Myrica.
Gaultheria procumbens L. Wintergreen.
In the upper part of the Botanic Garden.
Gaylussacia frondosa (L.) T. & G. Black Huckleberry.
In the upper part of the Botanic Garden.
Ginkgo biloba L. (Salisburia adiantifolia Salisb.) Ginkgo Tree.
West of College Hall. Trees of this kind are usually more nearly conical.

Ginseng. See Panax.
*Gleditschia triacanthos L. Honey Locust.
North of the Aboretum in Oakwood; in a hedge north of the Horticultural Laboratory.
Golden Bell. See Forsythia.
Gooseberry. See Ribes.
Green Briar. See Smilax.
Gum-tree. See Liquidamber.
Gum-tree, Sour. See Nyssa.
*Gymnocladus dioica (L.) Koch. (G. canadensis Lam.) Kentucky Coffee-bean Tree.
East of College Hall and one to the northwest; near the drive along the river known as the "Boulevard."
Hackberry. See Celtis.
Halesia. See Mohrodendron.
Hamamelis japonica Sieb. & Zucc. Japanese Witch Hazel.
On the bank north of the Botanic Garden.
*Hamamelis Virginiana L. Witch Hazel.
On the bank north of the Botanic Garden.
Hawthorn. See Cratægus.
Hazle-nut. See Corylus.
Hemlock. See Tsuga.
Hercules Club. See Aralia.
Hickory. See Hicoria.
*Hicoria minima (Marsh) Britton. (Carya amara Nutt.)
East of house number 3, several trees.
*Hicoria ovata (Mill) Britton. (Carya alba Nutt.) Shagbark Hickory.
East of the President's house.
*Hicoria sulcata (Willd.) Britton. (Carya sulcata Nutt.) King Nut.
In the Arboretum, row number 20 from the west.
*Hippophæ rhamnoides L. Buckthorn.
West of the pear orchard near the west entrance to the Campus.
Holly. See Ilex, Ilicioides.
Honeysuckle. See Lonicera.
Hop Hornbeam. See Ostrya.
Hop-tree. See Ptelea.
Hornbeam. See Carpinus.
Horse Chestnut. See Æsculus.
Huckleberry. See Gaylussacia and Vaccinium.
*Hydrangea paniculata Sieb. & Zucc. (H. paniculata *grandiflora.)
West of the Horticultural Laboratory; west of the small pond in the Botanic Garden; others in Botanic Garden are: H. arborescens, H. hirta Siebold, L. H. ramosa, H. scandens Maxim., H. radiata Walt.
*Hypericum Kalmianum L. Kalm's St. John's Wort.
In the southwest part of the Botanic Garden, west of the lower pond.
*Hypericum prolificum L. Shrubby St. John's Wort.
In the southwest part of the Botanic Garden; northeast of the west entrance to the Campus.
Ilex opaca Ait. American Holly.
Some rods south of residence number 10.

*Ilex verticillata (L.) A. Gray. Winter Berry. Black Alder.
In the upper part of the Botanic Garden; north of the Secretary's office.

*Iliciodes mucronata (L.) Britton. (Nemopanthes canadensis DC.). Mountain Holly.
In the upper part of the Botanic Garden.

Ironwood. See Ostrya.

Ivy, American. See Parthenocissus.

Ivy, Boston. See Ampelopsis.

Ivy, Japan. See Ampelopsis.

Ivy, Poison. See Rhus.

*Juglans cinerea L. Butternut.
East of house number 4; near the west part of the Arboretum.

*Juglans nigra L. Black Walnut.
West of the brook below the Botanic Garden; near the electric car station; west of mechanical hall (an Arbor-day tree planted by mechanical students).

June Berry. See Amelanchier.

Juniper. See Juniperus.

*Juniperus communis L. Common Juniper.
On the stone wall at the head of the open brook.

Juniperus communis fastigata Hort. (J. hybernica.) Irish Juniper.
West of the Horticultural Laboratory; south of house number 9.

*Juniperus communis suecica Hort. Swedish Juniper.
Near the ferns in the Botanic Garden; southwest of Howard Terrace.

*Juniperus excelsa stricta Hort. (J. stricta Hort.)
In the hollow some distance north of Howard Terrace.

*Juniperus Sabina L. Savin.
North and west of Abbot Hall; west of house number 2.

*Juniperus Sabina procumbens Pursh. Creeping Juniper.
Near the drive and south of Howard Terrace.

*Juniperus virginiana L. Red Cedar.
East of Abbot Hall; on the river bank west of the President's house.

Kalmia angustifolia L. Lamb Kill.
In the Botanic Garden in the moss house and in the upper part of the garden.

Kalmia glauca Ait.
In the moss house of the Botanic Garden.

*Kerria japonica DC.
Near the brook in the upper part of the Botanic Garden with the Spiræas.

Lamb Kill. See Kalmia.

Larch. See Larix.

*Larix europæa DC. European Larch.
Northwest of College Hall; rows 31, 32, 33 of the Arboretum.

Larix laricina (Du Roi) Koch. (L. americana Michx.) American Larch. Tamarack.
East of Howard Terrace.

Leather Leaf. See Chamædaphne.

Leatherwood. See Dirca.

Leucothoe racemosa (L.) A. Gray.
In the upper part of the Botanic Garden.

Lever-wood. See Carpinus.

*Ligustrum japonicum tricolor Hort.
A little northeast from the west entrance to the Campus.

Lilac. See Syringa.

Linden. See Tilia.

Lindera. See Benzoin.

Liquidamber styraciflua L. Sweet-gum Tree.
West of the pear orchard on the hill.

*Liriodendron Tulipifera L. Tulip Tree.
East of College Hall; north of the Physical Laboratory.

Locust, Honey. See Gleditschia.

Locust. See Robinia.

*Lonicera japonica Thunb. Japanese Honeysuckle.
In the Botanic Garden east of the Chemical Laboratory.

*Lonicera japonica variegata Hort. Variegated Japanese Honeysuckle.
West of the Horticultural Laboratory.

Lonicera orientalis Lam. Oriental Honeysuckle.
Northwest of the Botanical Laboratory.

*Lonicera sempervirens L. Scarlet Trumpet-Honeysuckle.
South of houses numbers 9 and 10; in the east part of the Botanic Garden.

*Lonicera Sullivantii A. Gray. Sullivant's Honeysuckle.
In the Botanic Garden west of the Chemical Laboratory.

*Lonicera tatarica L. Tartarian Honeysuckle.
West of the Veterinary Laboratory; northwest of the Botanical Laboratory.

*Lonicera tartarica grandiflora rubra Hort. Large-flowered Tartarian Honeysuckle. Pink-flowered.
In the border northeast of the Library.

Lonicera.
The following are to be seen in the upper part of the Botanic Garden: Lonicera Alberta L. cœrulea dependens Hort. L. ciliata Muhl., L. dioica L., glauca Hook., L. glaucescens, L. gracilis Kurz, L. hellenica Orph., L. hirsuta Eaton, L. involucrata Banks, L. oblongifolia Hook.

Maclura. See Toxylon.

*Magnolia acuminata L. Cucumber-tree.
East of the Chemical Laboratory; west of the President's house below the pear orchard.

Magnolia Frasera Walt.
In the northeast part of the Arboretum.

*Magnolia macrophylla Michx.
Northeast of the west entrance to the Campus.

Magnolia Soulangiana Hort.
Northeast of the west entrance to the Campus.

Magnolia virginiana L. (M. glauca L.)
In the northeast part of the Arboretum; northeast of the west entrance to the Campus.

Maiden-hair Tree. See Ginkgo.

Maple. See Acer.

Maple, Sugar. See Acer.

Meadow Sweet. See Spiræa.

Menispermum canadense L.

Mock Orange. See Philadelphus.

*Mohrodendron carolinum (L.) Britton. (Halesia tetraptera L.) Silver-bell Tree.

On the west slope west of the pear orchard on the hill; in the Botanic Garden northwest of the greenhouse.

Moosewood. See Dirca.

*Morus alba L. White Mulberry.

West of the Horticultural Laboratory.

Morus alba pendula Hort. Tea's Weeping Mulberry.

West of the Horticultural Laboratory.

Morus alba tatarica Hort. Weeping Russian Mulberry.

South of the Vegetable Garden; west of the Horticultural Laboratory.

Morus intermedia Hort. (M. Japonica Audib.) Japanese Mulberry.

West of the pear orchard on the hill.

*Morus rubra L. Red Mulberry.

Southwest of the greenhouse on the river flats.

Mountain Ash. See Sorbus.

Mulberry. See Morus.

Myrica cerifera L. Bayberry.

To be seen west of the ferns in the Botanic Garden; on the west slope west of the pear orchard on the hill.

Myrica Gale, L. Sweet Gale.

West of the ferns in the Botanic Garden.

Negundo. See Acer.

Neillia. See Opulaster.

Nettle-tree. See Celtis.

Ninebark. See Opulaster.

*Nyssa aquatica L. (N. sylvatica Marsh.) Pepperidge.

In the Botanic Garden where it was planted one Arbor Day by the co-eds.

Olive. See Elæagnus.

*Opulaster amurensis Kuntze. Ninebark.

Near the brook in the upper part of the Botanic Garden.

*Opulaster opulifolia (Benth and Hook.) Ninebark.

Near the brook in the upper part of the Botanic Garden; northeast of the "Big Stone," set up by the class of '73.

*Opulaster opulifolia aurea Hort. Golden Ninebark.

West of the Botanical Laboratory; in the border north of the Library.

Osage Orange. See Toxylon.

*Ostrya virginiana Mill. Iron Wood.

Northwest of the Physical Laboratory.

*Oxydendron arboreum (L.) DC. (Andromeda aborea L.)

In the northeast part of the Arboretum; in the upper part of the Botanic Garden.

*Pæonia Moutan Sims. Tree Peony.
In the Botanic Garden north of the greenhouse.

Paliurus australis Gaertn., (P. aculeatus Lam.) Christ Thorn.
Northeast of the west entrance to the Campus.

*Parthenocissus quinquefolia (L.) Planch. (Ampelopsis quinquefolia Michx.)
On the northeast corner of the Secretary's office; on the President's house, east and west sides; south side of house number 10.

*Parthenocissus tricuspidata (Sieb. & Zucc.) Planch. (Ampelopsis veitchii Hort.) Japan Ivy. Boston Ivy.
North of Williams' Hall; on the Library; south of houses numbers 1 and 9.

Papaw. See Asimina.

Pea-tree, Siberian. See Caragana.

Pear. See Pyrus.

Peony. See Pæonia.

Pepperidge. See Nyssa.

Philadelphus. Mock Orange.
The following are to be seen in the Botanic Garden west of the upper pond: *P. coronarius L., *P. Gordonianus Lindl., *P. grandiflorus Willd., *P. graniflorus floribundus Hort., P. inodorus L., P. japonicus, P. Lewisii Pursh, P. microphyllus A. Gray, and others recently planted.

Philadelphus coronarius foliis aureis Hort. Gold-leafed Mock Orange.
West of the Botanical Laboratory.

Physocarpus. See Opulaster.

*Picea canadensis (Mill.) B. S. P. (P. alba Ait.) White Spruce.
West of the Horticultural Laboratory; north of the Library.

*Picea Engelmanni Engelm. Engelmann's Spruce.
Southwest of the Botanical Laboratory.

*Picea excelsa Link. Norway Spruce.
The most common and the most variable evergreen on the Campus. Southwest and southeast of dwelling house number 7; northeast and near College Hall; a weeping tree north of the electric-car depot.

*Picea Mariana (Mill.) B. S. P. (P. nigra Ait.) Black Spruce.
Near the west entrance to the Campus; in swamps at the north of the College.

*Picea orientalis Carr. Oriental Spruce.
Northwest of College Hall; some rods south of residence number 10.

*Picea pungens Engelm. Colorado Blue Spruce.
West of the Botanical Laboratory; west of the Horticultural Laboratory; south of dwelling house number 10.

*Pinus Cembra L. Cembrian Pine.
Southeast of the Armory; north of College Hall.

*Pinus divaricata (Ait.) Sudw. (P. Banksiana Lamb.) Jack Pine. Gray Pine.
Northwest of College Hall; north of Abbot Hall.

*Pinus Laricio nigricans Hort. (P. austriaca Hoess.) Austrian Pine.
South of the pear orchard; east of College Hall; west of the Chemical Laboratory.

*Pinus montana Mughus Willk. Dwarf Pine.
North of College Hall; west of the pear orchard by the President's house; west of house number 3.

*Pinus resinosa Ait. Red or Norway Pine.
West of the playground north of the Union Literary Building.

*Pinus Strobus L. White Pine. Weymouth Pine.
East and west of dwelling house number 7; south of the pear orchard on the hill.

*Pinus Strobus nanus Hort. Dwarf White Pine.
Some rods south of residence number 10.

*Pinus sylvestris L. Scotch Pine.
Southeast of house number 3; southwest of house number 9; west of pear orchard that is near the President's house.

*Pinus virginiana Mill. (P. inops Ait.) Jersey Scrub Pine.
Between College Hall and Abbot Hall.

Platanus occidentalis L. Buttonwood Sycamore.
West of the play ground.

Platanus orientalis L. Oriental Plane Tree.
In row 23 of the Arboretum.

Populus alba L. Silver Poplar.
East of the Chemical Laboratory.

*Populus alba pyramidalis. Pyramidal Poplar.
In the east part of the Arboretum.

*Populus balsamifera L. Balsam Poplar.
In the Arboretum in row 28.

*Populus balsamifera candicans (Ait.) A. Gray. Balm-of-Gilead Poplar.
In the west part of the Campus, west of the pear orchard.

*Populus deltoidea Marsh. Cottonwood.
East of Abbot Hall, growing from seed dropped there about 1865. So said Professor Prentiss.

*Populus deltoidea aurea Hort. (P. monilifera Van Geerti.) Golden Poplar.
North of the Horticultural Laboratory.

*Populus grandidentata Michx. Large-toothed Aspen.
Southwest of Williams Hall; on the bank southwest of the President's house.

*Populus nigra pyramidalis Spach. Lombardy Poplar.
South of the barn near dwelling house number 10.

Populus Simonii Carr.
Northeast of Woman's Building.

*Populus tremuloides Michx. American Aspen.
South of the Botanic Garden near the river; on the bank south of the President's house.

Prickly Ash. See Zanthoxylum.

Privet. See Ligustrum.

Prunus allegheniensis Porter. Porter's Plum.
In the north part of the Botanic Garden.

*Prunus americana Marsh. Wild Plum.
In the north part of the Botanic Garden; northeast of Howard Terrace; west of the Horticultural Laboratory.

Prunus angustifolia Marshall. (P. chicasa Michx.) Chickasaw Plum.
Between the Horticultural Laboratory and the Library.
Prunus Avium L. Mazzard Cherry.
West of dwelling house number 2.
Prunus cerasifera atropurpurea Hort. Purple-leaved Plum.
East of College Hall.
Prunus Cerasus flore albo pleno Hort. Double-flowered Cherry.
West of the Horticultural Laboratory.
Prunus cuneata Raf.
Near dwelling house number 10.
Prunus domestica L. Common Plum.
Northeast of the Horticultural Laboratory.
Prunus domestica variegata Hort. Variegated-leaved Plum.
West of the Horticultural Laboratory.
Prunus hortulana Bailey. Wild Goose Plum.
Prunus Mahaleb L. Perfumed Cherry.
Northeast of the Horticultural Laboratory.
*Prunus maritima Wang. Beach Plum.
West of the Horticultural Laboratory.
Prunus nana flore roseo pleno Hort. Pink Double-flowering Almond.
On the north bank of the upper part of the Botanic Garden.
*Prunus nigra Ait.
In the north part of the Botanic Garden.
Prunus Padus L. Bird Cherry.
North of the Horticultural Laboratory.
*Prunus pennsylvanica L. Red Cherry.
In the north part of the Botanic Garden near the stone steps.
Prunus Pseudo-cerasus Lindl.
East of the Woman's Building.
*Prunus pumila L. Sand Cherry.
In the north part of the Botanic Garden.
*Prunus serotina Ehrh. Black Cherry.
Near each of the two sets of steps that are north of the Botanic Garden; northeast of house number 7.
*Prunus virginiana L. Choke Cherry.
North part of the Botanic Garden.
Prunus Watsoni Sargent.
Northeast of the cold storage house.
Prunus.
Besides those elsewhere mentioned, the following are growing in the Botanic Garden, north side: P. demissa (Nutt.) Walp., P. persica Stokes, P. tomentosa Thunb.
*Pseudotsuga Douglasii Carr. Douglas' Spruce.
West of the Botanical Laboratory.
*Ptelea trifolia L. Hop-tree.
In the north part of the Botanic Garden.
*Pyrus coronaria L. Wild Crab Apple.
West of College Hall; in the hedge west of the Vegetable Garden.
*Pyrus floribunda Nichols.
In the northeast part of the Botanic Garden.

Pyrus.

The following are to be seen in the upper part of the Botanic Garden: P. betulæfolia Bunge, P. baccata L., P. Malus L., P. Toringo Sieb.

Pyrus. See, also, Aronia.

*Quercus alba L. White Oak.

South and west of College Hall; near the path and southwest of the Horticultural Laboratory. The last one was planted on Arbor day by the Delta Tau Delta fraternity.

Quercus Cerris L. Turkey Oak.

West of the pear orchard on the hill.

*Quercus coccinia Wang. Scarlet Oak.

Northeast of Williams' Hall.

*Quercus crispula Blume. A Japanese Oak.

East of the Woman's Building.

*Quercus glandulifera Blume. A Japanese Oak.

East of the Woman's Building.

*Quercus ilicifolia Wang.

Near the west entrance to the Campus.

*Quercus imbricaria Michx. Shingle Oak.

West of the pear orchard on the hill; in the Arboretum east of the European Larches.

*Quercus lyrata Walt. In row 42 of the Arboretum.

*Quercus macrocarpa Michx. Burr Oak.

West of the pear orchard on the hill; near the brook as it enters the river.

*Quercus minor (Marsh) Sargent.

Near the west entrance to the Campus.

*Quercus Muhlenbergii Engelm. (Q. Prinus acuminata Michx.) (Q. castanea Muhl.) Chestnut Oak.

In the Botanic Garden northwest of the greenhouse.

*Quercus nana (Marsh) Sargent.

Near the west entrance to the Campus.

*Quercus palustris Moench. Pin Oak.

West of the pear orchard on the hill.

Quercus pedunculata Ehrh. European Oak.

South of the playground south of the drive.

*Quercus platanoides (Lam.) Sudw. (Q. bicolor Willd.) Swamp White Oak.

In the southeastern part of the deerpark; rows numbers 1 and 2 of the Arboretum.

*Quercus rubra L. Red Oak.

On the east end on the north side of the Botanic Garden.

*Quercus velutina Lam. (Q. coccinia tinctoria A. Gray.) Black Oak.

West of the Secretary's office; east of College Hall.

Raspberry. See Rubus.

Retinospora. See Gupressus. Thuya.

*Rhamnus cathartica L. Buck Thorn.

In the north portion of the Botanic Garden; east of College Hall.

Rhodora canadensis L.

In the upper part of the Botanic Garden.

*Rhus aromatica Ait. (R. canadensis Marsh.) Fragrant Sumach.

On the bank north of the large pond in the Botanic Garden.

*Rhus copallina L. Dwarf Sumach.

North of the Secretary's office; in the Botanic Garden above the larger pond.

*Rhus glabra L. Smooth Sumach.

On the bank east of the smaller pond in the Botanic Garden.

*Rhus glabra laciniata Hort. Cut-leaved Sumach.

North of the Library; in the Botanic Garden above the upper pond.

*Rhus hirta (L.) Sudw. (R. typhina L.) Staghorn Sumach.

On the bank north of the larger pond in the Botanic Garden.

Rhus radicans L. (R. Toxicodendron radicans Marsh. Poison Ivy.

In the Botanic Garden on the small island in the upper pond.

Rhus Vernix L. (R. venenata DC.) Poison Sumach.

On a small island in the upper pond in the Botanic Garden.

Ribes.

The following can be seen in the Botanic Garden west of the smaller pond: R. alpinum L., *R. aureum Pursh, R. cereum Dougl., *R. Cynosbati L., R. fasciculatum Sieb & Zucc., R. fasciculatum chinensis, *R. floridum L'Her., R. gracile Michx., R. Grossularia L., *R. oxyacanthoides L., R. rotundifolium Michx., *R. rubrum L.

*Robinia hispida L. Rose Acacia.

On the north part of the Botanic Garden; near the seven willows east of Abbot Hall.

*Robinia Pseud-acacia L. Common Locust.

West of the Botanic Garden; southwest of the Library.

*Robinia viscosa Vent. Clammy Locust.

In the north part of the Botanic Garden.

Rosa.

The following can be seen in the upper part of the Botanic Garden: *R. acicularis Lindl. (R. Sayii Schwein.), R. alpina L., R. arkansana Porter, R. arvensis Huds., *R. blanda Ait., R. canina L., R. carolina L., *R. Crimson Rambler Hort., *R. damascena Hort., Dawson Rose, R. grandiflora (?) R. gymnocarpa Nutt., R. humulis Marsh. (R. parviflora), *R. Luciæ Franch & Rochebr. (R. Wichurinana Crep.), *R. lucida Ehrh., R. mollis Presl., *R. multiflora Thunb., R. nitda Willd., R. nutkana Presl., *R. omissa Desegl., *R. rubiginosa L. (R. micrantha Smith), R. rubiginosa major (R. rubrifolia Vill.), *R. setigera Michx., R. spinosissima L., R. tomentosa Sm., R. Woodsii Lindl., Yellow Rambler, and others recently planted.

Rose. See Rosa.

Rubus.

The following species can be seen in the northeast part of the Botanic Garden: R. canadensis L., Rubus deliciosus Torr., R. leucodermis Daug., R. Millspaughii Britton, R. occidentalis L., R. odoratus L., R. parviflorus Nutt. (R. nutkanus Mocino), R. setosus Bigel., R. strigosus Michx., R. villosus Ait.

Salix alba L.

Southwest of the Boiler House.

*Salix alba britzensis Hort.

Northeast of the west entrance to the Campus.

*Salix alba vitellina Hort. White Willow.
By the foot bridge east of Abbot Hall.
Salix Caprea pendula Hort. Kilmarnock Willow.
Below the larger pond in the Botanic Garden.
Salix palmifolia.
A staminate willow to be seen southwest of the Engine House.
Salix pentandra L. Laurel-leaved Willow.
In the southwest part of the Botanic Garden.
Salix rosmarinifolia L. Rosemary-leaved Willow.
In the Botanic Garden below the larger pond.
*Salix. Wisconsin Weeping.
South of the drive and west of the Physical Laboratory.
Salix.
The following may be seen below the lower pond in the Botanic Garden: Salix adenophylla Hook., S. amygdaloides Anders., S. babylonica annularis Hort., S. candida Fluegge, S. cordata Muhl., S. discolor Muhl., S. glaucophylla S. glaucophylla brevifolia Bebb, S. humilis Marsh, S. incana, S. longifolia Muhl., S. lucida Muhl., S. nigra Marsh, S. petiolaris J. E. Smith, S. purpurea L., S. rostrata Richards, S. sericea Marsh, and perhaps others.
*Sambucus canadensis L. Purple-berried Elder.
In the Botanic Garden west of Chemical Laboratory.
*Sambucus nigra aurea foliis aureis Hort. Golden Elder.
East of house number 10; between the Library and the Horticultural Laboratory.
Sambucus nigra foliis argenteis variegatis Hort. Variegated Elder.
West of the Horticultural Laboratory and the Library; west of College Hall.
Sambucus pubens Michx. (S. racemosa Hook.) Scarlet-berried Elder.
In the Botanic Garden west of the Chemical Laboratory.
Sassafras Sassafras (L.) Karst (Sassafras officinale Nees and Eberm.)
Southwest of dwelling house number 4; south and near the depot of the electric railway.
Savin. See Juniperus.
Service-berry. See Amelanchier.
Shad-bush. See Amelanchier.
Shrubby Trefoil. See Ptelea.
Silver-bell Tree. See Mohrodendron.
Smilax glauca Walt. (S. spinulosa J. L. Smith.)
Among the lilies in the upper part of the Botanic Garden.
Smilax hispida Muhl. Green Briar.
Among the lilies in the upper part of the Botanic Garden.
Smilax Pseudo-China L.
Among the lilies in the Botanic Garden.
Smoke Tree. See Cotinus.
Snow-ball. See Viburnum Opulus.
Solanum Dulcamara L. Bitter-sweet.
West of the larger pond in the Botanic Garden.
Soprora japonica L.
With the Leguminosæ in the Botanic Garden; near the west entrance to the Campus.

Sorbus americana Marsh. (Pyrus americana D. C.) American Mountain Ash.

In the upper part of the Botanic Garden.

Sorbus Aucuparia. (Pyrus Aucuparia Gaertn.) European Mountain Ash.

Southwest of house number 5; west of the greenhouse.

Sorrell-tree. See Oxydendron.

Sour-gum. See Nyssa.

Sorrel-tree. See Oxydendron.

Spice-bush. See Benzoin.

Spindle Tree. See Euonymus.

Spiræa.

The following can be seen in the upper part of the Botanic Garden: S. alpina Pall., S. cana Waldst. & Kit., S. canescens Don., S. cantoniensis Lour., *S. cantoniensis flore pleno (S. carpinifolia Willd.), *S. confusa mollis, S. crenata L., *S. discolor Pursh (S. ariæfolia Smith), *S. Douglasii Hook., *S. japonica L. fil., *S. prunifolia flore pleno Hort., *S. salicifolia L., *S. sorbifolia L., *S. Thunbergii Sieb. & Zucc., S. tomentosa L., *S. trilobata L., *S. Van Houttei Briot. (Media trilobata), and others recently planted.

Spruce. See Picea.

*Staphylea Bumalda DC. Staphylea colchica Stev. Staphylea pinnata L.

Near the brook in the upper part of the Botanic Garden.

*Staphylea trifolia L. Bladder Nut.

West of College Hall near the steps; on the river bank below the Botanic Garden.

St. John's Wort. See Hypericum.

Sugar berry. See Celtis.

Sumach. See Rhus.

Sweet Pepperbush. See Clethra.

Sycamore. See Platanus: Acer pseudo-platanus.

*Syringa vulgaris L. Common Lilac.

Southeast of dwelling house number 4; northwest part of the Botanic Garden.

Syringa Josikæa Jacq., f. Josika's Lilac.

West of College Hall; southeast of the President's house; north of the Library.

*Syringa pekinensis pendula Hort. Pendulous Pekin Lilac.

East of house number 10; southwest of Howard Terrace.

*Syringa persica L. Persian Lilac.

West of College Hall; north of the Secretary's office; northwest part of the Botanic Garden.

*S. amurensis Rupr.

In the northwest part of the Botanic Garden.

*S. japonica Decne.

In the northwest part of the Botanic Garden.

*S. oblata Lindl.

In the northwest part of the Botanic Garden.

*S. pekinensis Rupr.

In the northwest part of the Botanic Garden.

*S. villosa Vahl. (S. pubescens Turcz.)

In the northwest part of the Botanic Garden.

*Syringa vulgaris alba Hort. White Lilac.
north of College Hall; east of the President's house; northwest part of the Botanic Garden.

The following varieties can be seen between Williams' Hall and the Library:

*S. vulgaris alba grandiflora Hort.
*S. vulgaris Beranger Hort.
*S. vulgaris Charlemberg Hort.
*S. vulgaris gigantea Hort.
*S. vulgaris Gloire de Lorraine Hort.
*S. vulgaris Jacques Calot Hort.
*S. vulgaris Lemoinei flore pleno Hort.
*S. vulgaris Louis van Houtte Hort.
*S. vulgaris Marie LeGraye Hort.
*S. vulgaris noisettiana alba Hort.
*S. vulgaris President Massart Hort.
*S. vulgaris Professor E. Stockhardt Hort.
*S. rothomagensis rubra Hort.
*S. vulgaris rubra insignis Hort.
*S. vulgaris Ville de Troyes Hort.
*S. vulgaris virginalis Hort.

Tamarack. See Larix.

Tamarix africana Poir.
Near the west steps on the north side of the Botanic Garden.

Tamarix chinensis Lour.
Near the west steps on the north side of the Botanic Garden.

Tamarix murensis. ?
Northwest of house number 11; reported to have been received from Professor Budd of Iowa.

Tamarix Narbonne. ?
Near the west steps on the north side of the Botanic Garden.

*Taxodium distichum (L.) L. C. Rich. (Cupressus disticha L.) Bald Cypress.
Northwest of College Hall; north of the Secretary's office. Found in the swamps of the southern states.

*Taxus baccata L. European Yew.
Northeast of the Botanical Laboratory.

*Taxus minor (Michx.) Britton, (T. canadensis Willd.) American Yew.
West of the ferns in the Botanic Garden.

*Tecoma radicans Juss. Trumpet Flower.
In Botanic Garden south of the pond.

*Thuya occidentalis L. American Arbor Vitæ. White Cedar.
Much planted. A little north of the Botanical Laboratory; three in a group northwest of house number 7; east and north of the same house near the drive; a hedge northeast of the Horticultural Laboratory.

*Thuya occidentalis compacta Hort. Compact Arbor Vitæ.
Southwest of Howard Terrace.

*Thuya occidentalis globosa Hort. Globose Arbor Vitæ.
A plant may be seen east of the main greenhouse near the drive.

Thuya occidentalis filifolia Hort. ·Thread-like Arbor Vitæ.
Near the hedge northeast of the Botanical Laboratory.

*Thuya occidentalis pendula Hort. Weeping Arbor Vitæ.

*Thuya occidentalis pyramidalis Hort. Pyramidal Arbor Vitæ.
West of house number 2; north of Abbot Hall; southeast of house number 9.

*Thuya occidentalis Sibirica Hort. Siberian Arbor Vitæ.
A compact round-topped, dwarfed evergreen. Southwest and near the Chemical Laboratory; south of Howard Terrace; southeast of the President's house.

*Thuya occidentalis spiralis Hort. Spiral Arbor Vitæ.
In the hollow some distance south of Howard Terrace; northeast of the Botanical Laboratory; some distance south of dwelling house number 10.

*Thuya occidentalis vervæneana Hort.
Southeast of house number 9; some rods south of dwelling house number 10.

*Thuya orientalis L. (Biota orientalis Eudl.) Oriental Arbor Vitæ.
West of house number 10.

*Tilia american L. Basswood.
West of the Physical Laboratory near the steps approaching the Botanic Garden; south of dwelling number 3.

*Tilia argentea Desf. Silvery Linden.
West of the Library.

*Tilia europæa L. European Basswood.
In the east part of the Arboretum.

Tilia platyphyllos Scop.
In row 34 of the Arboretum.

*Tsuga canadensis (L.) Carr. Hemlock.
Northwest of the greenhouse, near the Botanic Garden; southeast of the President's house; south of Howard Terrace.

*Toxylon pomiferum Raf. (Maclura aurantiaca Nutt.) Osage Orange.
As a hedge southwest of Wells' Hall; in the Arboretum.

Tulip Tree. See Liriodendron.

*Ulmus americana L. American Elm.
West of the Farm House; north of Abbot Hall; along the road north of M. A. C.

*Ulmus campestris L. English Elm.
East of Wells' Hall.

*Ulmus montana With. Scotch Elm. Wynch Elm.
East and a little south of the President's house.

*Ulmus pubescens Walt. (U. fulva Michx.) Red Elm. Slippery Elm.
Near the brook southeast of Abbot Hall; south of the greenhouse on the river flats; in the hollow near the path between College Hall and Bachelor's Hall.

*Ulmus racemosa Thomas. Rock Elm.
South of the east end of Howard Terrace; southeast of the Chemical Laboratory.

Vaccinium.

The following species are to be seen in the upper part of the Botanic Garden: V. canadense Richards, V. corymbosum L., V. pennsylvanicum Lam., V. straminium L., V. vacillans Kalm.

*Viburnum Opulus L. Snowball.

West of the playground; between College Hall and Abbot Hall; in the upper part of the Botanic Garden.

Viburnum.

Besides those noticed elsewhere, the following may be seen in the upper part of the Botanic Garden: V. acerifolium L., V. alnifolium Marsh (V. lantanoides Michx.), V. cassanoides L., V. dentatum L., V. erosum Thunb., *V. Lantana (V. rugosum), V. molle Michx., *V. Opulus japonicum, V. prunifolium L., V. pubescens (Ait.) Pursh., and others recently set.

Virgilia. See Cladrastis.

Virginia Creeper. See Parthenocissus.

*Vitex Agnus-castus L.

Northeast from the west entrance to the Campus; in the lower part of the Botanic Garden.

Vitis.

The following are represented south of the brook and near it in the upper part of the Botanic Garden:

V. æstivalis Michx.
V. arborea L. (Cissus stans Pers.)
V. bicolor Le Conte.
V. cordifolia Lam.
V. indivisa Willd.
V. Labrusca L.
V. riparia Michx.

Wahoo. See Euonymus.

Walnut. See Juglans.

Whitewood. See Liriodendron.

*Willow. Wisconsin Weeping.

Near the drive crossing the brook. See, also, Salix.

Winter Berry. See Ilex.

Wintergreen. See Gaultheria.

*Wistaria chinensis D C. Chinese Wistaria.

On the President's house; west of the greenhouse.

Witch Hazel. See Hamamelis.

*Xanthoceras sorbifolia Bunge.

Northeast from the west entrance to the Campus.

Yellow Wood. See Cladrastis.

Yew. See Taxus.

*Zanthoxylum americanum Mill. Prickly Ash.

Near the steps at the northwest in the Botanical Garden.

REPORT OF THE DEPARTMENT OF MATHEMATICS AND CIVIL ENGINEERING.

To the President:

Sir—Basing my estimate of efficiency upon the results apparent and upon comparison with those of other years, I must rate the year past as an average one in the history of this department. The separate terms have not been finished with the same degree of satisfaction. The spring term, particularly, seemed too short for the work it was necessary to crowd into it, the instructors had not time for all the duties required of them, and the percentage of student failure in class work was large. We were well prepared for the fall term class work, thanks to the appointment of two new instructors. In the winter term too, we were not much overcrowded although one instructor withdrew. It seems, however, a mistake to call satisfactory an arrangement which compels the head of the department to give all his time to teaching, and leaves no opportunity to properly superintend and direct the other work naturally falling to the position.

INSTRUCTION.

Reviewing the data upon which to base judgment, it appears that efficiency in any particular class which has been taught in the department is inversely proportional to the size of the sections into which the class is divided, after the number in the sections passes a certain mark. This limit is not a fixed one, nor is it the same for all kinds of work. My judgment would suggest twenty as about the maximum number that can be dealt with in a single section, in studies taught by us, if the best results are to be attained. It must be understood in this connection that we are trying to teach young men and women to do things, to give them practical knowledge of the subjects studied; and this requires attention to the individual. More than half of the fifty-nine sections taught this year by us have contained over twenty members each.

The personnel of the department has changed considerably since last year. At the opening of the fall term two new instructors were appointed, Mr. L. L. Locke and Mr. A. H. Parrott. These young men have done very good work during the year in their various assignments. Mr. W. O. Beal remained with us as instructor during the fall term, at the end of which he resigned to take up studies in another institution. Thus it will be seen that there were five teachers in the department in the fall term and only four in the winter and spring terms. Assistant Professor Babcock continued with us and has answered all calls upon his abilities in a manner no less satisfactory than in the past. I would recommend him and Instructors Locke and Parrott to your kindly consideration as worthy of receiving material appreciation of their fidelity and earnest labors for the college.

The following text-books have been used in our classes during the year: Beman & Smith's Higher Arithmetic by the class in mensuration; Wells' Essentials of Algebra by the women and agricultural students; Hall & Knight's College Algebra (Sevenoak's revision) by mechanical students; Wentworth's Geometry by women and agricultural students; Phillips & Fisher's Geometry (abridged) by mechanical students; Jones' Trigonometry; Tanner & Allen's Analytic Geometry; Taylor's Calculus; Hodgman's Surveying; Johnson's Surveying for all classes in civil engineering; Church's Mechanics; Merriman & Jacoby's Graphic Statics.

We have given 124 special examinations during the year, some of which were for admission to advanced standing and some to make up back work.

The assignments of our teachers to class work, the number of students enrolled, etc., are shown by the tabulation presented below.

Class work of the department of mathematics and civil engineering for the college year 1900–01.

Class.	Subject.	Number of course.	Teacher.	Class room.	Hour of meeting.	No. of hours per week.	No. of students in class.
Fall term:							
Freshmen	5 year algebra	Math. 1c.	Prof. Babcock	6, College Hall	8–9	5	31
"	" "	" "	" "	6, " "	3–4	5	24
"	M. algebra	" 1b.	Mr. Beal	Abbot Hall	10-11	5	15
"	M. "	" "	Mr. Locke	6, College Hall	2-3	5	27
"	M. " (5yr.)	" 1e.	Mr. Parrott	Abbot Hall	9-10	5	23
"	Ag. algebra	" 1a.	Mr. Beal	8, College Hall	9-10	5	17
"	Ag. "	" "	Mr. Locke	2, " "	8-9	5	28
"	Ag. "	" "	Mr. Parrott	8, " "	10-11	5	26
"	Ag. "	" "	" "	8, " "	11-12	5	17
"	M. geometry	" 2d.	Mr. Beal	6, " "	1-2	5	24
"	M. "	" "	Mr. Locke	2, " "	11-12	5	14
"	M. " (5y.)	" "	Mr. Parrott	Abbot Hall	8-9	5	16
Sophomores	M. trigonometry	" 4b.	Prof. Vedder	2, College Hall	10-12	5	30
"	M. "	" "	Mr. Beal	8, " "	8-9	5	33
"	Ag. geometry	" 2b.	Prof. Babcock	6, " "	10-11	5	24
"	Ag. "	" "	Mr. Locke	6, " "	9-10	5	26
Juniors	Surveying (class)	Civ. Eng. 1b.	Prof. Vedder	2, " "	9-10	2	26
"	" (field)	" " "	" "		1–3	2	14
"	" "	" " "	" "		1–3	2	12
"	Integral calculus.	Math. 6.	Prof. Babcock	6, College Hall	11-12	5	33
Seniors	Graphic statics	Civ. Eng. 4.	Prof. Vedder	2, " "	9-10	3	14
"	Ag. Civ. Eg. (class)	" " 2.	" "	2, " "	3–4	5	11
"	" " " (field)	" " "	" "	2, " "	8-10:50	2½	9
Totals	23 Sections					101½	494
Winter term:							
Freshmen	M. algebra	Math. 1f.	Prof. Babcock	6, College Hall	11-12	5	21
"	M. "	" "	Mr. Locke	8, " "	11-12	5	15
"	M. "	" "	Mr. Parrott	Abbot Hall	11-12	5	18
"	M. " (5yr.)	" 1d.	" "	6, College Hall	8–9	5	30
"	M. " "	" "	" "	6, " "	9-10	5	19
"	Ag. algebra	" 1b.	Prof. Babcock	6, " "	1-2	5	29
"	Ag. "	" "	Mr. Locke	8, " "	8-9	5	29
"	Ag. "	" "	Mr. Parrott	6, " "	2-3	5	26
Sophomores	Analytic geom	" 5.	Prof. Babcock	6, " "	10-11	5	28
"	" "	" "	Mr. Locke	8, " "	10-11	5	28
Juniors	Mech. of Eng	" 7a.	Prof. Vedder	2, " "	8–9	5	28
Seniors	Ag. Eng	Civ. Eng. 3.	" "	2, " "	9-10	5	5
"	Hydraulics (class)	" " 5.	" "	2, " "	11-12	5	8
"	" (lab.)	" " "	" "	2, " "	1-3	4	7
Totals	14 Sections					69	291

Class work.—Continued.

Class.	Subject.	Number of course	Teacher.	Class room.	Hour of meeting.	No. of hours per week.	No. of students in class.
Spring term:							
Freshmen	M. trigonometry	Math. 4b.	Prof. Babcock	6, College Hall	11-12	5	26
“	M. “	“ “	Mr. Locke	Abbot Hall	11-12	5	21
“	Ag. geometry	“ 2a.	“ “	“ “	9-10	5	18
“	Ag. “	“ “	“ “	6, College Hall	3-4	5	24
“	W. “	“ “	Mr. Parrott	6, “ “	8-9	5	13
“	W. “	“ “	“ “	8, “ “	3-4	5	13
“	M. “ (5yr.)	“ 2c.	Mr. Locke	6, “ “	2-3	5	16
“	M. “ “	“ “	Mr. Parrott	8, “ “	11-12	5	27
“	Mensuration	“ 3.	Prof. Babcock	Abbot Hall	3-4	5	19
“	“	“ “	Mr. Locke	“ “	10-11	5	23
Sophomores	Differential Cal	“ 6a.	Prof. Babcock	6, College Hall	9-10	5	24
“	“ “	“ “	“ “	6, “ “	10-11	5	26
“	Ag., Pl. Trig	“ 4a.	Prof. Vedder	2, “ “	8-9	3	29
“	“ “ “	“ “	Mr. Parrott	8, “ “	10-11	3	18
“	Ag. Sur. (class)	Civ. Eng. 1a.	Prof. Vedder	2, “ “	8-9	2	52
“	“ “ (field)	“ “ “	Profs. Vedder and Babcock		1-3	2	16
“	“ “ “	“ “ “	“ “		1-3	2	15
“	“ “ “	“ “ “	“ “		1-3	2	20
“	W. geometry	Math. 2b.	Mr. Parrott	8, College Hall	9-10	5	6
Juniors	Mech. of Eng	“ 7b.	Prof. Vedder	2, “ “	10-11	4	26
Seniors	M. Civ. Eng. (class)	Civ. Eng. 6.	“ “	2, “ “	9-10	5	17
“	M. “ “ (field)	“ “ “	“ “		1-3	2	17
Totals	22 Sections					90	466
Grand totals	59 Sections					260½	1,251

RECOMMENDATIONS.

At the time of making this report the Board of Agriculture has authorized the appointment of another instructor in this department for the coming year. This action is much appreciated and will no doubt simplify the problem of class subdivision. However, it hardly needs to be pointed out that for the greatest efficiency of our teaching force there must be as many class-rooms as there are instructors. At present there are available for our purposes only four class-rooms. Five will be needed next year.

I would like to repeat a recommendation which has appeared in several of my annual reports. It is that there be provided a room in which we could store our instrumental equipment, and which could also be used as an experimental laboratory where the adjustment and construction of instruments could be studied. Such a place would be especially valuable in wet weather when field work in surveying is not possible. With our present lack of even an adjusting pier indoors, on rainy days we must excuse the classes in field work and much time is lost that might be turned to good account if we had a laboratory under roof. Besides, it is neither convenient nor economical to make the department office also the general store-room and instrument depository, as it is now.

There is a demand for a course of study founded upon and consisting largely of the same general elements as our present mechanical course, but allowing some little specialization along civil engineering lines. You are aware that every year a number of prospective students ask if our mechanical course affords adequate preparation for future work in city and railroad surveying, structural engineering and the like. A considerable number of every entering class take up their work here with the expressed intention of making civil engineering their profession. Some of these graduate here and complete their study elsewhere, more leave us before graduation, and a few of our graduates have done successful work in civil engineering without studying in any other college.

Believing that a course could easily be arranged to satisfy the apparent demand mentioned, a course that would keep with us until graduation many of those who will otherwise leave us at an earlier time, and one that would even attract students on account of its desirability and merits, I would urge that you use your good offices in causing the college to offer instruction in a few more civil engineering studies. I submit that the best way to do this would be to offer options of the studies desired in place of the machine design of the mechanical course. The time is favorable for the beginning of such options, even if it happens that those who elect to take advantage of them are among those who would otherwise complete the mechanical course. I am told that classes in technical mechanical subjects have reached the limit beyond which additional teaching force will be required to care for them. The probable result of offering these options would be to relieve somewhat the overcrowding of classes in machine design; and if they should prove popular, scarcely any more teaching force will be necessary for both courses than for the same number of students all in the old course.

EQUIPMENT.

There have been added to our instrumental equipment a plane-table with accessories, two new surveyors' compasses, a range finder, a Thacher computing instrument, a large slide rule, a machinist's rod, a telescoping rod, a Philadelphia rod, a binocular hand level and a split-second timer. Supplies of hand axes, baskets, plumb-bobs and the like, which were low at the beginning of the year, have been replenished. The total expenditure by the department during the year for the above items and for stationery, postage, etc., is $447.

The inventory of department property, including instrumental equipment, class-room and office furniture, observatory apparatus and tools shows an aggregate of $4,536.53 on June 30, 1901, as against $4,065.52 last year.

SURVEYS, ETC.

We have surveyed the athletic field acquired by purchase last summer, have revised the general campus map from which was made an engraving for the college directory, and have referenced extensions of the sewer, water and steam lines when these have come to our knowledge.

In addition to the regular departmental work, this year I have been required to assume part of the functions of college registrar, classifying students of the freshman mechanical classes at the beginning of each term. While possibly this new arrangement may be an improvement so far as the classification is concerned, I have felt at each of the three periods upon which the bulk of the work falls that the time taken for this purpose is filched from something else to which it rightfully belongs in the college economy. If there is one time above another when classes need all the teacher's time and energy it is at the beginning of a term. It is dangerous to the vigor of the term's work to start with an inferior degree of that quality.

Respectfully submitted,
H. K. VEDDER,
Professor of Mathematics and Civil Engineering.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1901.

REPORT OF THE DEPARTMENT OF ZOOLOGY AND PHYSIOLOGY.

To the President:

SIR—I have the honor to submit the following report of the Department of Zoology and Physiology for the year ending June 30, 1901:

The schedule of classes for the year was as follows:

Fall term—Economic Zoology for senior agriculturals and women, elective, 34 students. Anatomy and Physiology for sophomore agriculturals, required, 62 students. Anatomy and Physiology for sophomore women, required, 25 students. Total for term, 121 students.

Winter term—Geology for senior agriculturals, elective, 19 students. Geology for senior women, elective, 7 students. Anatomy and Physiology for sophomore agriculturals, required, 52 students. Anatomy and Physiology for sophomore women, required, 19 students. Physical Geography for sub-freshman 5-year mechanicals, required, 52 students. Entomology for fruit course specials, 5 students. Total for term, 154 students.

Spring term—Entomology for senior agriculturals, elective, 10 students. Entomology for junior horticulturals (Hort. 6 a), 15 students. Entomology for sophomore agriculturals, required, 50 students. Total for term, 75 students.

This gives a total of 350 students for the year, and when it is remembered that most of the classes have as much laboratory work as class-room work, and that the laboratory sections are necessarily twice or three times as numerous as the classes, the amount of work for the teaching force can be better appreciated.

The Department handled 125 more students this year than last year, and without an additional assistant this would have been impossible. In response to my urgent request at the close of last year the Board kindly granted an allowance of $200 for such assistance and the Department was fortunate in securing the services of William T. Shaw, a graduate of the University of Minnesota, who had spent most of the preceding year in the Department in post-graduate work in zoology. It was arranged that he should continue to give half his time to work for his M. S. degree, the remainder to be spent as Instructor in Zoology. His work has been eminently satisfactory, but it will be impossible to keep him another year without a substantial increase in salary, and it is evident that the work of the coming year will demand the entire time of such an assistant. In this connection I would again call attention to the insufficient laboratory facilities of the department, and the over-crowded condition of the Museum, and would respectfully urge that steps be taken at once to better these conditions.

With the exception noted above there has been no change in the personnel of the department during the year, nor has there been any great change in the equipment, the most important additions to the latter being a set of eight Rand & McNally wall maps for the teaching of physical geography, and a set of 23 stereopticon slides illustrating Alaskan glaciers, for use in the classes in geology and physical geography. The work in the last named study is now confined to the mechanical students of the five-year course, but, as previously suggested, it should be extended to all the courses and in any event to the agricultural course.

In addition to the work scheduled above, the Department offered two weeks of service for farmers' institutes during the fall term, but no work was assigned. In compliance with the request of the superintendent, I prepared an illustrated lecture on the more valuable birds of the state, to be given at the round-up institute, but owing to lack of time for the program only a fragment of it was given. I have also had in preparation for the past year a bulletin on the Birds of Michigan, for which there would seem to be a demand in view of the phenomenal development of interest in birds throughout the country, and the utility of such information in connection with nature study in the schools and the relations of birds to the restriction of injurious insects. The constant pressure of other duties, however, prevents rapid progress and it is not probable that this bulletin will be ready for the printer before autumn or winter.

WALTER B. BARROWS,
Professor of Zoology and Physiology.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1901.

DEPARTMENT OF ENGLISH AND MODERN LANGUAGES, MICHIGAN AGRICULTURAL COLLEGE.

Agricultural College P. O., Mich.

President J. L. Snyder:

SIR—The work in this Department for the year 1900-1901 has not varied greatly from that reported for the previous year (see report for 1899-1900). The plan for the work has remained the same, and the number of students has not varied sensibly; hence the number of class-sections and the daily program for the Department has not been materially changed. Mr. King has emphasized the elocutionary work of the Department with good effect and has aroused considerable enthusiasm among the students for that much-needed kind of training. In the spring term the annual inter-collegiate oratorical contest was held at this college, and the comparative excellence of our methods of training in literature, logic, history and rhetoric, as well as in elocution, was demonstrated by the fact that our representative, Mr. George D. White, in competition with the representatives of the purely literary colleges and theological seminaries of the State, won second place on the thought and style of his oration and third place in the general result.

With regard to the other members of the Department, I do not need to mention to you the continued excellence of Miss Blunt's work; nor is the earnestness and success of the new member, Miss Wellman, unknown to you.

By an arrangement sanctioned by you and the Board of Agriculture formally, I took over, as a part of my personal work, the editorship of the "M. A. C. Record," in addition to the editing of the College catalogue and the arranging of the college daily programs. As this was not possible without the relinquishment of some of my own class-work, one-half of the time of your advertising assistant, Mr. Victor E. Brown, was placed at my disposal. I have taught three of the Department classes each term and have given Mr. Brown partial charge of two. I have given much time and labor to the preparation of the weekly issues of the "Record," requiring of Mr. Brown only a weekly round of the departments to collect such news as they had to give. If the opinions, voluntarily expressed to me, both in writing and by word of mouth, are any criterion for judgment, the usefulness and popularity of the College organ have been greatly enhanced. My idea had been to make the "Record" not an advertising folder, nor indeed a *direct* advertising medium at all, but to establish and maintain a journal that should be newsy, bright and suggestive, that should contain the best and most advanced thought at the College, and that for the sake of the solid value of its contents should be sought after and read; thus, it seemed to me, the influence of the College would be widened, its area of usefulness would be enlarged, and the College itself would be advertised in a way, indirect indeed, but most lasting and effective. How far I have succeeded you and the members of the Board of Agriculture must judge. In the work I owe many thanks for the help accorded me by my colleagues of the Faculty and by others; and in this connection I may mention my honored friend Dr. Beal.

I have recommended to you that since so large a portion of my time is already taken up in the preparation of matter that is to go out from the College to the public through various channels, a literary and advertising bureau, to handle all such official matter, including the direct advertising, be established and recognized as a part of the work of the Department, and that such assistance as is needed be provided. I hope that it will be recognized that, while Mr. Brown is catalogued as an instructor in English, no addition to the actual teaching force of the Department has been made, but that a mere transfer of additional work to the Department makes it so appear.

I take this opportunity to thank yourself, the Board of Agriculture, my colleagues of the Department and of the Faculty generally, and the students, for forbearance, kindly sympathy, and most unselfish and efficient help in my work during my recent deep affliction. Especially would I mention the extended leave of absence so cordially granted and so sadly necessitated.

Very respectfully submitted,
HOWARD EDWARDS,
Professor of English and Modern Languages,
Michigan Agricultural College.

THOROUGHFARE, VA.,
July 30, 1901.

REPORT OF THE WOMEN'S DEPARTMENT.

To the President:

SIR—I have the honor of submitting the following report of the Women's Department for the year ending June 30, 1901:

The classes have been carried on as follows:

FALL TERM.

Seniors.—Domestic Science 4, by Miss Crowe. Physical Culture j, by Miss Avery.

Juniors.—Domestic Art 2, by Mrs. Haner. Physical Culture g, by Miss Avery.

Sophomores.—Domestic Art 1a, by Mrs. Haner. Domestic Science 2a, by Professor Marshall. Music d, by Mrs. Marshall. Physical Culture d, by Miss Avery.

Freshmen.—Domestic Science 1a, by Miss Lyford. Music a, by Mrs. Marshall. Ethics a, by Dean Keller. Physical Culture a, by Miss Avery.

WINTER TERM.

Seniors.—Domestic Science 5, by Miss Crowe. Physical Culture k, by Miss Avery.

Juniors.—Domestic Art 3, by Mrs. Haner. Physical Culture h, by Miss Avery.

Sophomores.—Domestic Art 1, by Mrs. Haner. Domestic Science 2b, by Miss Crowe. Music e, by Mrs. Marshall.

Freshmen.—Domestic Science 1b, by Miss Lyford. Ethics b, by Dean Keller. Music b, by Mrs. Marshall. Physical Culture b, by Miss Avery.

SPRING TERM.

Seniors.—Domestic Art 4 and 5, by Mrs. Haner. Physical Culture m, by Miss Avery.

Juniors.—Domestic Science 3, by Professor Marshall and Miss Lyford. Physical Culture i, by Miss Avery.

Sophomores.—Domestic Art 1c, by Mrs. Haner. Domestic Science 2c, by Dean Keller. Music f, by Mrs. Marshall. Physical Culture f, by Miss Avery.

Freshmen.—Domestic Science 1c, by Miss Lyford. Ethics c, by Dean Keller. Music c, by Mrs. Marshall. Physical Culture by Miss Avery.

At the beginning of the College year the Women's Department moved into the Women's Building, then in process of completion. The formal opening of this building, which occurred October 25, was one of the most important events of the year, one full of promise owing to the fact that for the first time the Women's Department of the College and many of the most prominent women of the State were brought together.

In addition to the regular work in class-rooms and laboratories, members of the Department have been active at Farmers' Institutes, the Grange and at Farmers' Clubs.

The equipment of the Women's Department with an estimated value is recorded in the inventory.

The resignation of the head of the Women's Department was tendered early in the Spring Term.

Respectfully submitted,
MAUD RYLAND KELLER,
Dean Women's Department.

AGRICULTURAL COLLEGE, MICH.,
June 30, 1901.

REPORT OF THE MILITARY DEPARTMENT.

Dr. J. L. Snyder, President, Michigan Agricultural College:

SIR—I have the honor to render for the information of the Agricultural Board and yourself the following report of the condition of the Department of Military Science and Tactics, for the College year ending June 19, 1901.

The Corps of Cadets have been instructed in the School of the Soldier, Company and Battalion, in close order. In the ceremonies including Guard Mounting, Parade, Review and Inspection and sending for the colors. The Sophomore class have had the principles of extended order drill thoroughly explained to them, and have had quite a good deal of drill in the School of Tactics. Classes for the commissioned and non-commissioned officers, outside of the regular drill hours, have been maintained during the most of the winter term. Attendance on these classes has been entirely voluntary on the part of the cadets. During the winter term the Sophomore class had recitations in drill regulations. During the term I lectured to the class on four military subjects.

I am well satisfied with the progress made, and believe the future will prove to the College authorities and to the cadets the benefits to be derived from the military instruction, which, if it accomplished nothing else, certainly gives the cadets a more correct carriage and better deportment.

I most urgently request that the Faculty see their way to a change of hours for the work of my Department. In the service men are instructed in their military duties when they are at their best, all drill and ceremonies taking place in the morning. During this winter many of the cadets of the Sophomore class went to sleep during class hours. No notice of this was taken, as I felt sure they were worn out with the work they had already done and were certainly not in a condition to receive instruction. It would be better to have a half or three-quarters of an hour five times a week at some time in the morning or afternoon, not later than four o'clock, than the present system, three times a week between five and six o'clock, when the cadets are worn out with their academic, agricultural and shop work. It is my intention to advance the work and make it more interesting to the Corps this coming year.

The commissioned officers of the Corps who graduate with this year's class are well fitted for commission in the National Guard of the State, or in the volunteers.

Very respectfully,
C. A. VERNOU,
Major U. S. Army. Professor of Military Science and Tactics.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

REPORT OF VETERINARY DEPARTMENT.

To the President:

Sir—I have the honor of making the following report for the Veterinary Department for the year ending June 30, 1901.

The work of the Department during the past year has been carried on in a manner similar to that of last year. The free clinic has furnished a number of interesting specimens for the benefit of those taking the work. This phase of the work has been better than last year and it is to be hoped that it will continue to be better each year.

In the class-room those seniors electing the work of the Department have received instruction with reference to the anatomy of the farm animals, the diseases which affect these animals, including their causes, symptoms and treatment; the preventive and hygienic treatment receiving special attention. The medicines used in treating the diseases of our domesticated animals were discussed as to their source, appearance, physiological action, uses and doses, along with the various modes of administration. We keep in mind that the students expect to become stockmen, rather than veterinarians and plan our work accordingly. We try to impress upon the students the importance of preventing the spread of contagious diseases by proper quarantine and sanitation. There is a large field for work along this line throughout the State, and we try to interest the students to such an extent that they will work along this line in their own communities after leaving college. During the last three weeks of the fall term two hours each day were spent in the dissecting room, dissecting an old horse destroyed for the purpose. This work, after having studied the anatomy in the class-room, using the model of the horse, along with models of various organs of other animals, gives the student a very good idea of the gross structure of the farm animals. The pathological and other specimens, which have been collected for the Department museum, are of great value as illustrations. All the teaching has to be done by lectures, as there are no text-books which are suited to the wants of our students.

During the first half of the winter term all the young men in the Sophomore class received thirty lectures, including a discussion of the most common digestive disorders, the most common lamenesses, along with a few other disorders that are frequently met with; also the accidents and diseases incident to parturition and the special diseases of the dairy cow. In this course a number of the lectures are devoted to the care and feeding of animals to prevent disease.

About the same lectures as given to the Sophomores were also given to the special short course students during the first half of the winter term.

Respectfully submitted,
GEO. A. WATERMAN,
Professor of Veterinary Science.

Agricultural College, Mich.
June 30, 1901.

REPORT OF DEPARTMENT OF DRAWING.

To the President:

DEAR SIR—I have the honor to present herewith the report of the work done in the Department of Drawing for the college year ending June 23, 1901:

Miss Holt resumed her duties at the opening of the fall term, having spent a profitable year in pursuing her studies in Boston. You may be interested in hearing that Miss Sprague, Miss Holt's substitute during her leave, has a good position in a western college at a fair salary—$1,000 the second year.

The program of studies has been the same as for last year, and the distribution of work among the members of the teaching force has also been practically the same.

I wish to acknowledge the very satisfactory character of the work done by my assistants. Both Mr. Newman and Miss Holt are faithful and efficient instructors.

You have already received a report of Mr. Newman's visit to other institutions in the interest of the Department. We confidently look for beneficial results in the near future. During the spring term Mr. Newman devoted a good deal of time to the preparation of a student's record, using the card system, to replace the record book we have heretofore kept. A comprehensive Department inventory similar to the one in use in the Mechanical Department is also in process of preparation.

The Department has purchased a half interest in a stereopticon, the other interest belonging to the Horticultural Department. So far the partnership has been quite satisfactory and the lantern has been very useful.

Thanking you for your appreciation of the work of the Department.

I remain faithfully,
W. S. HOLDSWORTH,
Asst. Prof. of Drawing.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

REPORT OF THE DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING.

To the President:

Sir—I have the honor to submit herewith the report for the Department of Physics and Electrical Engineering for the year ending June 30, 1901.

Through the generous action of the Board in creating the position of permanent instructor, and appointing thereto Mr. A. H. Taylor, who had served for part of a year in the Department, it was made possible to begin the differentiation of the work for the students of the separate courses; as well as to introduce laboratory methods in each course. The results obtained, in increased interest and in putting the work upon a firmer basis, both of usefulness and scholarship, have been very encouraging. The pressing need for larger facilities for laboratory work, both in instruction and equipment, has been urged upon your notice in another communication. For two terms of the year it has been necessary to engage student aid in handling the large classes. This expedient, always a doubtful one, should be made unnecessary by the increasing of the teaching force. The creation of an assistantship in laboratory would be a relief from this expedient.

During the year a card index system for record keeping has been purchased, and the keeping of the record of all students enrolled in the department placed upon a permanent foundation. There has been added the usual complement of new apparatus to the extent of available funds. The policy of purchasing a few good pieces, rather than many indifferent ones, has been continued, even while recognizing that the scope of our work is thereby unfortunately restricted, usually at the expense of the student's time.

Considerable expense has been incurred in providing adequate means for protecting and preserving the apparatus already belonging to the department. This end can only be economically and successfully attained by removal to especially constructed quarters, free from dampness and corroding chemical fumes.

The class-work conducted during the year has been carried on in accordance with the following schedule:

Schedule of class work, 1900–1901.

Term.	Subject.	*Hours per week.		†No. of students.		
		Recitations.	Laboratory.	Ag.	M.	W.
Fall	Physics 2c	5		50		
	Physics 2d		10	50		
	Physics 2g	5	6		63	
Winter	Physics 2a	4		58		
	Physics 2e	4	6		46	
	Physics 3a	4	4			33
	Physics 3	3	2			20
	Elect. Eng. a	5	4		8	
Spring	Physics 2b	4	5	51		
	Physics 2f	4	6		42	
	Physics 3b	4	4			27
	Physics I	3	4		49	
	Physics 4	2	3	4	1	
Totals		47	54	213	209	80

* Total hours, 101.
† Total enrollment, 502.

Permit me to close this report with an acknowledgment, through yourself, to the Honorable Board of Agriculture, of the appreciation of the Director of this Department of their intention shown to strengthen and develop the work under his charge.

Respectfully submitted,
MARTIN D. ATKINS,
Asst. Prof. of Physics and Elect. Eng.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

REPORT OF THE DEPARTMENT OF HISTORY AND ECONOMICS.

To the President:

I have the pleasure of submitting the following report of the work done in this Department during the year 1900-1901.

A class of twenty seniors elected advanced United States history during the autumn term and a class of twenty-five members of the women sophomore class were given instruction in European history. Both classes met five times per week. In the winter term forty seniors elected political economy, forty-seven juniors were given instruction in civics and seventeen members of the junior women's class were given instruction in early European history. Each of these classes met me five times per week, except the one in civics, which met four times per week in two sections. The work of the spring term was devoted to the freshmen of the women's and agricultural courses. Ninety-seven of the members of this class met me five times per week in one or the other of the four divisions for instruction in English history.

Respectfully submitted,
WILBUR O. HEDRICK.

Agricultural College, Mich.
June 30, 1901.

REPORT OF THE DEPARTMENT OF BACTERIOLOGY.

President J. L. Snyder:

Dear Sir—It has been the purpose of the Department of Bacteriology and Hygiene to furnish to the students who undertake the work offered a knowledge of the fundamental principles involved in the subjects designated. To accomplish this both laboratory and class-room are utilized for their presentation.

The course in Bacteriology extends throughout the year. It may be regarded as a unit-course, inasmuch as its completion is essential to an applicable knowledge. In the laboratory the student is brought in contact with germ life and its functions, leading him to look upon a microorganism as having a real existence with a concrete relationship to nature. The experience thus obtained paves the way for an understanding of the lectures which extend beyond the laboratory acts and are made more comprehensive, because of the inability of the student to cover a very wide range in his limited laboratory observations. Each year this work is proving more valuable and essential to students through the experience gained in adapting the work to their exact needs.

but it cannot be made fully what it ought to be, owing to a severe lack of laboratory space.

The Hygiene studies embrace a course in Sanitary Science given to the sophomore young ladies and Dietetics given to the junior young ladies.

Sanitary Science in its application to the home is what predominates in the instruction, although frequently it becomes necessary to deviate from this well defined path to secure such information as will be useful to women in their relation to the community.

In the short time given to dietetics, it is only possible to present the bare skeleton of facts upon which the science of dietetics clings. It is to be deplored that a full term cannot be offered to the junior young ladies in this basic subject, for it takes them out of traditional methods and beliefs into the field of science and truth.

Besides the preceding regular work, this Department has had three "short course" classes during the winter term. These were "Dairy Bacteriology and Hygiene," "Farm Bacteriology and Hygiene" and "Cheese-making Bacteriology."

"Dairy Bacteriology and Hygiene" attempts to furnish the simplest principles and facts of these subjects to those "short course" men, who are making their course conform to a narrow field of work in the home dairy or creamery. We strive in "Farm Bacteriology and Hygiene" to especially adapt the lectures to those taking up "Live Stock Husbandry" for a few weeks. In the pursuing of "Cheese-making Bacteriology" there is a constant effort to provide the students of the "short course" with a knowledge of the biological processes involved in cheese-making.

Very respectfully submitted,

CHARLES E. MARSHALL.

AGRICULTURAL COLLEGE, MICH.

June 30, 1901.

REPORT OF THE DEPARTMENT OF PHYSICAL CULTURE.

Mr. President:

It is with a feeling of satisfaction that I present this my second annual report.

Although we were not successful in foot ball and base ball, we had most satisfactory success in basket ball, winning every inter-collegiate game, and in the annual Michigan Inter-Collegiate Athletic Association Field Day, held at Hillsdale, June 7 and 8.

In this field day we won the outdoor meet and the indoor contests, and came in second in the tennis tournament, making a total of 103 points, the nearest college being Albion with 64 points, and Ypsilanti Normals third with 37 points.

With the completion of the new Women's Building, the young women have been exercising in the gymnasium contained in above building, under the very able direction of the instructor, Miss Avery. The gymnasium was fitted up at an expense of $275, and all classes have been given systematic training during the entire three terms. The effort has been directed towards developing the vital powers especially, as also in strengthening the weak parts and giving special work for muscular deformities.

Respectfully submitted,
CHAS. O. BEMIES.

Agricultural College, Mich.
June 30, 1901.

REPORT OF THE DEAN OF THE SPECIAL COURSES.

President J. L. Snyder:

I submit herewith a brief report of the work done for the special students in the short courses.

This work has been seriously handicapped in the past by the want of a suitable building wherein the technical work could be carried forward. Thanks to the generosity of the people of the State, a sightly, commodious, and convenient dairy building was erected during the summer of 1900, and was ready for occupancy by the time for the opening of the special courses in January, 1901. In this building are located the main butter-making room, with its steam separators, churns, workers, and combined churns and workers, its cream vats, and other equipment made and needed for the instruction of the art of making butter in the factory; next, a cheese room, large enough to hold from six to eight cheese vats; a testing room equipped for instruction in the operation of the Babcock test and the use of the lactometer. In the basement are the cheese curing rooms, cold storage, lockers, and store room. Over the cheese and butter-making room are offices and class-rooms. The building affords facilities for instruction of large classes in both cheese and butter-making.

All courses except in cheese-making and beet sugar production began January 8, and continued six weeks. The attendance was as follows:

Fruit, 4; cheese, 11; creamery, 24; live stock and dairy husbandry, 21; beet sugar, first term, 15; beet sugar, second term, 19. Total, 94. Names repeated, 15. Net total, 79.

The courses in creamery and dairy husbandry were under the immediate charge of Mr. John Michels, who was assisted by Mr. C. B. Martin, of Hanover, and Mr. R. L. Brown, of the Agricultural College. Mr. Martin gave special attention to separators and churns, and Mr. Brown devoted himself to the instruction in milk testing by the Babcock test and the lactometer, with the lessons as to the composition of milk under various conditions.

The manufacturers donated the use of a full line of their wares, otherwise the College owns a fairly complete equipment for instruction along dairy lines. The milk was purchased not, as was planned, from parties living near the College, but from Mr. H. A. Smith, Wixom, Michigan. The transportation of the milk this long distance necessarily added very materially to its cost.

To give thorough instruction in butter-making it is necessary to have the quantity of milk sufficient to run the large steam separators an hour or more to provide sufficient cream for the combined churn and worker.

The total quantity of milk used in the creamery course was 65,232 pounds and 27,000 pounds for the cheese course. Courses other than those in the dairy work are not expensive. Where the milk can be purchased at a reasonable price, the receipts for products sold ought to pay for the milk, but during this campaign the butter was produced just at the time when it was lowest in the market, and the cheese met with reluctant sale; first, because retailers as well as wholesalers have adopted in Michigan the plan of purchasing cheese in June and July, when it is cheapest, putting it in cold storage for sale in the spring months, and second, because the milk used in the cheese course was at least thirty-six hours old when it reached the College, and was too ripe to make the best quality of cheese. Again, dairy products cannot be sold to good advantage when their manufacture takes place at short intervals during the year. A regular trade cannot be worked up. For these reasons I deem it a matter of considerable importance that the supply of milk to the College be continued during the year.

The course in fruit culture does not seem to meet with popular approval, as evidenced by the number of students in attendance. The work in that course is intensely practical, and cannot fail to be valuable to anyone connected with fruit growing.

Notwithstanding the high price of meat, it is apparent to me that the general trend in live stock matters is toward the dairy rather than away from it. While creameries have been unsuccessful in many parts of the State, a rather wide observation leads me to believe that the number of dairy cows in Michigan is increasing. Heretofore the demand for men to manage creameries has been so intense that the College has done wisely in catering to that demand by teaching young men how to run separators, do all the detail work of the creamery, and keep its accounts. I am of the opinion, however, that it will be well in the future to throw into relative prominence the production of forage and the care of the cow. The demand for our special students to manage creameries has been good, and there remain but few of our special students in dairy husbandry competent to manage a creamery that have not good positions. The same statement is true of the boys that have taken the cheese course. Nearly, if not quite, every one who came to the College with experience is making cheese in some factory.

Since the lectures in elementary agricultural chemistry came in the winter term it was possible to give last winter a preparatory course in general chemistry to the boys, not fully prepared, who were to take the technical work in beet sugar in the spring term. I am glad to report that this work was very satisfactory, and of great benefit to the fortunate young men who could attend. It would be very helpful to this new industry if the special course treating of beet production and the manufacture of sugar could be extended over the whole year. The factories lack men competent to intelligently manage the chemical work in a factory, and, at the same time, conduct operations in the field.

There is a still more urgent demand than for chemists. The factories need men trained along mechanical lines, expert in sugar making, trained to handle men and machines, and at the same time good business men. It would be well for the State if the College could supply this want.

Mr. A. N. Clark again gave instruction in technical factory management and the chemistry of the factory to the special students in the beet sugar courses. Mr. E. L. Aderhold, of Neenah, Wisconsin, was again the very efficient instructor in cheese-making.

Respectfully submitted,
C. D. SMITH, *Dean.*

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

REPORT OF THE SUPERINTENDENT OF INSTITUTES.

To the State Board of Agriculture:

There have been held during the year closing June 30, 1901, two-day county institutes in 63 counties, and 141 one-day institutes in 42 counties. The interest in the work has not declined, nor, as far as measured by attendance, has it notably increased. In the newer counties, the one-day institutes have been located in parts remote from large villages and the attendance has been, as expected, smaller. In one respect it has been pioneer work. A knowledge of correct methods, differing slightly perhaps from those in use, have been carried to people who have not the opportunity of studying for themselves what farmers elsewhere are doing. I am glad to report that the meetings in these so-called outlying districts have been greatly appreciated by the farmers who have attended them, and the coming of the institutes will mark the beginning of a decided improvement in the character of the live stock and of the care of the field crops.

In the older and more thickly settled parts of the State a somewhat radical change in methods is imperatively called for. The institute idea is not new, and therefore taking to the classes to be benefited by the meetings and the subjects treated have become somewhat hackneyed. It is therefore going to be anything but an easy matter to arrange programs in the future which shall be at once attractive and valuable to these more experienced communities. I believe that the trend is to be toward a rather more technical and scientific treatment of special phases of agricultural work than toward a more discursive and general exposition of general phases of the work by practical farmers. Matters must be gone more into detail. Limited and special phases of present problems must be treated at length. There is, therefore, to be a more emphatic call for men scientificially trained, if not college bred, for this work. It is therefore to be regretted that arrangements cannot be made at the College whereby the members of the faculty can go to the institutes.

The matter of selecting the topics for the program carries with it the question of selection of speakers. During the past year the method has been to use members of the faculty as far as possible and supplement that list by farmers selected because possessed of two essential qualities,—namely, ability to succeed on the farm in the lines of work about which they speak; and, second, ability to clothe their ideas in clear, terse, and accurate language, and illustrate them in a way to make their address, as a whole, attractive, as well as instructive. Naturally, men who succeed in their calling are seldom anxious to leave the farm because their presence there is one essential element of their success. The question of obtaining proper speakers at institutes is therefore an important and difficult one.

While the Superintendent of Institutes furnishes the State speakers and supplies the large part of the material for the program, it is left to the County Society to do the advertising, supply the bulk of the program for the evening session, furnish music and supply for the program the local speakers, who serve to give the exercises the local coloring so much desired. Unfortunately, the Secretary of the local society is not a paid officer, and the demands of his own business compel him often to neglect proper and sufficient advertising. I am glad to report that in the vast majority of the counties this matter is well cared for. It is wrong, however, to refer so important a phase of the work to the generosity of individuals. Some arrangement must be made in the near future whereby the burden of this work will be lifted from the shoulders of the local society.

The State Round-up Institute was held at the Agricultural College on the three days beginning February 26, 1901. The experiment was tried of having the general session in the afternoon, and dividing the people in attendance in the forenoon in such a way as to furnish separate programs to the women, to farmers interested in fruit culture, and to those interested in general farm work. Such an arrangement made possible a much broader program than could otherwise have been carried out. A reference to the full report of the Superintendent of Institutes, submitted today, will give full information in regard to the Round-up Institute, with a full report of its proceedings.

The conference of County Secretaries was a very important feature of the Institute at the College. Fifty-three counties were represented by delegates, and plans for the following year were well laid out.

The Farm Home Reading Circle, supported financially out of the Institute fund, has again increased in membership and usefulness during the past year. Books are being ordered freely and are being widely read by Michigan farmers and the members of their families as is evidenced by the answers to questions sent out for the examinations, and as well by the questions coming in, which denote an active interest in the proper solutions of present problems.

I must call the attention of the Board to the fact that the railroads are contributing generously to the College extension work. They carry our speakers to institutes at half fare and carry the superintendent about the State wherever he is called, whether to arrange for meetings or to deliver addresses, on passes. Through these two channels they donate nearly, if not quite, a quarter as much as the whole State.

The State appropriation for the carrying forward of the institute work was $5,500.

Respectfully submitted,

C. D. SMITH,
Superintendent of Institutes.

Agricultural College, Mich.
June 30, 1901.

REPORT OF THE LIBRARIAN.

To the President:

SIR—I have the honor to present the following report on the library for the year ending June 30, 1901:

Six hundred ninety-three volumes have been added to the library during the year, of which 246 came by purchase, 195 by binding, and 252 were donated.

We are indebted to the following persons for bound volumes:

Allen, L. J. M., 2 vols.
American Shorthorn Association, 3 vols.
Canada Government reports, 14 vols.
Connecticut State Board of Agriculture, 4 vols.
Continental Dorset Sheep Club, 1.
Detroit Evening News Publishing Co., 1.
Georgia Board of Agriculture, 1.
Holstein Friesian Association of America, 3.
Kansas Academy of Science, 2.
Kansas State Board of Agriculture, 1.
Leonard, W. S., 1.
Massachusetts State Board of Agriculture, 3.
Massachusetts Society for Promoting Agriculture, 1.
Michigan documents, 40.
Missouri Horticultural Society, 1.
Minnesota Geological and Natural Historical Survey, 9.
Munson, Prof. W. M., 1.
New York State University, 10.
New Jersey Geological Survey, 23.
Ohio Board of Agriculture, 1.
Rhode Island Board of Agriculture, 2.
Smithsonian Institution, 7.
Takvorian, Bedros, 1.
United States Government reports, 114.
Victoria Institute, England, 2.

Pamphlets and unbound volumes to the number of 299 have been received by gift, and as acknowledgment has been made in every case where the donor was known, individual mention is here omitted. Twenty-one pamphlets have been purchased.

One hundred forty-three publications, foreign and American, are purchased by the library and placed in the reading room for the use of students and faculty. In addition to these are the following publications which are regularly received as donations or in exchange for our own publications:

- Adrian Times.
- Albion Recorder.
- Allegan Gazette.
- Agricultural Epitomist.
- Agricultural Gazette, N. South Wales.
- American Bee Keeper.
  - Creamery.
  - Horsebreeder.
  - Horticulturist.
    - Phil. Society Proceedings.
  - Swineherd.
- Baltimore Sun.
- Battle Creek Journal.
- Capital City Democrat.
- Chicago Record-Herald (daily.)
- Church Helper.
- Corn Belt.
- Detroit Free Press (Twice-a-Week).
- Evening News (Saginaw).
- Farm and Fireside.
- Farmer's Voice.
- Farming.
- Farm, Field and Fireside.
- Farmers' Advocate.
  - Home.
  - Guide.
  - Journal.
- Farm and Home.
- Farm Journal.
- Fruit Growers' Journal.
- Good Health.
- Grand Traverse Herald.
- Grand Rapids Herald.
  - Democrat.
- Grange Bulletin.
- Homestead.
- Hillsdale Leader.
  - Standard.

Home Companion.
Hoard's Dairyman.
Home and Farm.
Indiana Farmer.
Industrialist.
Ingham County News.
Ionia Sentinel.
Jonesville Independent.
Journal of Agriculture.
Kalamazoo Telegraph.
Lansing Journal (daily).
Land of Sunshine.
Literary News.
Mark Lane Express (London).
Michigan Fruit Grower.
Monthly Weather Review.
Michigan Mirror.
Mirror and Farmer.
Michigan Advocate.
Monthly Bulletin Vital Statistics (Mich).
Moderator.
New England Florist.
New York Weekly Witness.
National Stockman and Farmer.
Otsego County News.
Onekama Lake Breeze.
Oregon Agriculturist.
Orange Judd Farmer.
Official Gazette.
Public Ledger (Phila.) daily.
Prat Institute Monthly.
Park's Floral Magazine.
Practical Farmer.
Proc. Amer. Soc. Civil Engineers.
Queensland Agricultural Journal.
Rhodora.
State Republican (daily).
Sault Ste. Marie News.
Sugar Beet.
St. Ignace News.
Salt Lake Herald.
Sound Currency.
Travelers' Record.
Traverse Bay Eagle.
Voice.
Western Agriculturist.
Plowman.
Wallace Farmer.
Western Society of Engineers.
Williamston Enterprise.
Ypsilantian.

The M. A. C. Record exchanges are also placed in the reading room, and in exchange for our catalogue, the library receives the year books, catalogues or registers from all the leading educational institutions of the country. We also receive the bulletins of the various State experiment stations, and of the U. S. Department of Agriculture.

During the year fines to the amount of $33 have been collected, and about 7,000 books have been loaned. (No record is kept of books used in the library.) One hundred fifty-three books have been repaired or rebound.

The library is open to students eleven hours daily, except Sunday, when the library hours are from 9 to 12 p. m.

The librarian has been assisted during the year by Miss Alice Cimmer, who has given part of her time to the library while pursuing a post-graduate course at the College. Her services have been faithful and painstaking.

The library of the Experiment Station grows slowly, 50 volumes have been added during the year; 5 by purchase, 20 by gift, and 25 by binding. The library now contains 1,944 volumes, which, with the main library of 20,379 volumes, gives a total of 22,323 volumes.

Respectfully submitted,
MRS. LINDA E. LANDON,
Librarian.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

ANNUAL REPORT OF THE MICHIGAN WEATHER SERVICE FOR THE YEAR ENDED JUNE 30, 1901.

The Michigan Weather Service has remained under the immediate charge of C. F. Schneider, who is detailed by the Chief of the United States Weather Bureau.

The headquarters office continues in the Federal Building at Lansing, Rooms Nos. 9 and 10.

No particularly new work has been taken up during the year, the entire energy being engrossed along the line of improving and extending the meteorological observation work and in more widely disseminating the daily forecasts, frost and cold-wave warnings furnished by the United States Weather Bureau.

VOLUNTARY OBSERVING STATIONS.

The number of voluntary observing stations at the close of the present year is 119, a net gain of 3 during the year. The distribution of these stations now extends to nearly every county in the State, Montmorency being the only county which has no meteorological station and it is hoped that by the close of the present year this exception will be erased.

As a whole, the work of the voluntary observers has been exceedingly efficient and satisfactory. It must be remembered that these observers perform their duties without extra pay and that the observations extend throughout every day of the year. The instrumental equipment of the various stations has not been extended in any way. The valuable data collected by the voluntary observers is collected at the Lansing office each month, where each report is carefully scrutinized, checked up and compiled.

The maintenance of these voluntary observing stations is one of the most expensive items in the instrument expenditures. The thermometers are quite fragile and many of them broken during the year. Instrument shelters become weather worn and have to be repainted and very often repaired. The average cost of the entire instrumental equipment for a single station is about $15, and the cost of replacing a single thermometer about $2.25. The cost of repainting an instrument shelter is about $2.50. Our experience has been that about one-third of the total number of thermometers out have to be replaced during the year and that instrument shelters be repainted about once every two years.

FORECAST DISTRIBUTION.

The number of forecast distributing centers in charge of this office is 63, of which 24 are for the sole purpose of furnishing forecasts to farmers along rural free delivery routes. Through the agency of the other 39 distributing centers nearly every postoffice in the State is now furnished with a daily forecast card that is received before about 5:00 p. m.; the card bears the forecast for a period "tonight and tomorrow." In addition to this a large number of business houses, factories, etc., are furnished with cards. Altogether, the Michigan Weather Service now supplies to its various distributing centers, 2,499 postoffices and business houses, and 7,366 rural mail boxes.

By co-operation with the postmasters at the termini of many of the rural free delivery routes this office is able to furnish the farmer with a daily forecast. These forecasts are placed in the boxes of the farmers about the same time that the cards reach their destination in the city. The rural distribution of weather forecasts has proved a very popular feature of the rural free delivery system.

WEEKLY CLIMATE AND CROP BULLETIN.

As in previous years this office has continued to publish a weekly bulletin during the planting, growing and harvesting seasons, which describes briefly for the State and each county the weather conditions of the preceding seven days and their effect on the progress of the various staple crops and farm field work. The bulletin continues to be published widely in the metropolitan press and smaller newspapers and is a very popular feature of our work. The bulletin is mailed to about 1,200 addresses, most of which are in Michigan, but a considerable portion of which also go outside of the State. This bulletin is furnished free on application to the Lansing office.

MONTHLY CLIMATE AND CROP BULLETIN.

A monthly bulletin, containing a statisical meteorological resume for each station, besides a small amount of explanatory text, has been issued monthly during the year. This bulletin is in conformity to a style suggested by the chief of the United States Weather Bureau, and adopted by other State Weather Services, as well as the Michigan Weather Service. The data is therefore easily comparable with that of other states. The data thus compiled is much referred to by a large, varying and increasing class of interests. Besides the data published in this bulletin, the Lansing office has furnished a very large amount of special meteorological data.

The record of observations is yearly becoming of more importance, as is evidenced by the largely increased demand for it. The service is becoming better known and its resources are being brought more and more into use by the public.

In conclusion I can only repeat that while no particularly new work has been taken up, the work in hand has been vigorously forwarded and the net-work of meteorological record has been very satisfactorily extended over another year of time. In addition it may be said that never before in the history of the weather bureau have we been able to place the forecasts and warnings in the hands of so many farmers as we are now doing. When it is remembered that the weather bureau was first organized for the sole purpose of warning the marine and agricultural interests of approaching weather conditions and that for many years the marine interests were benefited by the weather bureau many fold more than the agricultural interests and that it is only within the past few years that the weather bureau forecasts have been available to the farming class at large, it may be said that the original intention of the founders of the weather bureau is just beginning to see its fruition. The rapid extension of the rural free delivery mail service will do more to place the forecasts of the weather bureau in the hands of the farmers than any other agency, or agencies, have been able to do during the preceding thirty years.

C. F. SCHNEIDER,
Section Director.

LANSING, MICH.
June 30, 1901.

REPORT OF THE STATE INSPECTOR OF NURSERIES.

To the State Board of Agriculture:

HON. T. F. MARSTON, PRESIDENT—As State Inspector of Nurseries and Orchards, I make the following report, for the year ending August 1, 1901:

Nurseries inspected during the year............	47
Orchards visited during the year................	125
Orchards sprayed during the year...............	10

The nurseries of the State are in excellent condition, with no indication of the presence of San Jose scale.

Wooly Aphis was found in two nurseries; black peach Aphis in five, and Crown gall in two. In all of the above cases the stock has had proper treatment. There has been a marked improvement in the general health and condition of the principal nurseries of the State.

San Jose scale has increased in area in Ottawa county. This region has been carefully worked over by the local commissioners, who have done good work. This is a hard region to work in, and good results will be hard to get.

Scale has also broken out in Van Buren and Berrien counties. These colonies have been carefully worked over and all infested trees destroyed. I think that the colonies have been exterminated.

The Canker worm is still increasing, and doing a great amount of damage, especially to the old orchards. I have succeeded in getting a few commissioners to do work. But in most places I meet with resistance. The farmers do not want to help themselves, and refuse help from other sources.

Dealers and foreign nurserymen, have, as a rule, lived up to the requirements of the law. A few shipments have been stopped, not having the proper certificates.

The above, together with a large correspondence, has taken all of my time.

Respectfully submitted,
D. W. TRINE,
Inspector.

SPRINGPORT, MICH.
June 30, 1901.

NURSERYMEN.

The following nurserymen and dealers have done business in this State:

Name.	Postoffice.	State.
Allen Nursery Co	Rochester	New York.
Allen Nursery Co., W. E	Kalamazoo	Michigan.
Bogen, Nelson	Batavia	New York.
Bowman & Son, Thos. W	Rochester	“
Brown Bros. Co	Rochester	“
Bryant Bros	Dansville	“
Baldwin, O. A. E	Bridgman	Michigan.
Bragg, L. G. & Co	Kalamazoo	“
Biglow, J. U	Bangor	“
Buttrick & Beebe	Cascade	“
Bailey, H. A	Jackson	“
Central Michigan Nursery Co	Kalamazoo	“
Curtis, L. T	Flint	“
Cross, J. A	Spring Lake	“
Chase Bros	Rochester	New York.
Chase & Co., R. G	Geneva	“
Carlton Nursery Co	Rochester	“
Cole, W. B	Painesville	Ohio.
Davis Bros	South Haven	Michigan.
Dunham, Enos	Stevensville	“
Dressell, Gilbert	Hart	“
Dean, Geo. N	Shelbyville	“
Day, John	Fremont	Ohio.
Emmons & Co	Newark	New York.
Essig, W. W	Detroit	Michigan.
Empire State Nurseries	Waterloo	New York.
First National Nurseries	Rochester	“
Foote, O. C	Ogden	Michigan.
Flansburg & Peirson	Leslie	“
Grand Rapids Nursery Co	Grand Rapids	“
Goodell, E. W	Mayville	“
Greening Bros	Monroe	“
Gustin, C. F	Adrian	“
Green & Son, A. W	Michigan Center	“
Husted & Co., N. P	Lowell	“
Hamilton & Son, A	Bangor	“
Herbst, Wm. G	Maybee	“
Havekost, Geo. H	Monroe	“
Hoopes Bros. & Thomas	West Chester	Pennsylvania.
Herrick Seed Co	Rochester	New York.
Hawley & Sons, E	Hart	Michigan.
Ilgenfritz' Sons	Monroe	“
Jeffries, James	Kalamazoo	“
Jaquay & Co., Irving	Benton Harbor	“
Kellogg, R. M	Three Rivers	“
Knight, Daniel	Sawyer	“
Lewis, A. E	Lowell	“
Merrifield & Alton	Fremont	“
Michigan Nursery Co	Monroe	“
Maudlin, E	Bridgman	“
McGrayne, Fell & Co	Detroit	“
Moulson & Son, Geo	Rochester	New York.
Maple Grove Nurseries	Waterloo	“
North Jersey Nurseries	Springfield	New Jersey.

Name.	Postoffice.	State.
Nelson & Son, J. A.	Paw Paw	Michigan.
Nash, Charles C	Three Rivers	"
Perry Nursery Co	Rochester	New York.
Patty, D. H	Geneva	"
Pickett, G. S	Clyde	Ohio.
Prater, G. E. Jr	Paw Paw	Michigan.
Speilman Bros	Adrian	"
Stuart & Co., C. W	Newark	New York.
Sears & Co., Henry	Geneva	"
Stark Bros	Louisiana	Missouri.
Van Dusen & Co., C. L	Geneva	New York.
Wanner, Louis	Glenn	Michigan.
West Michigan Nurseries	Benton Harbor	"
Whitten, C. E	Bridgman	"
Weston & Co., A. R	Bridgman	"
Western New York Nursery Co	Rochester	New York.
Whitney & Co., G. W	Dansville	"

DEALERS IN NURSERY STOCK.

Name.	Postoffice.	State.
Archer & Vail	St. Joseph	Michigan.
Augustine, L. D	St. Joseph	"
Briscoe, J. A	Detroit	"
Blayden, Wm. P	Owosso	"
Culver, O. B	Colon	"
DuBois Ball Nursery Co	Port Huron	"
Davis, S. B	Jackson	"
Filer, A. C	Calumet	"
Hill, Wilson	Davison	"
Horton, D. D	Greenville	"
Lewis, G. H	Monroe	"
Lake Shore Nursery	St. Joseph	"
Lampson & Rual	Covert	"
Moshier, C. H	Paw Paw	"
Perry, J. W	Birmingham	"
Pilkenton, S. H	Portland	"
Souter, Geo. H	Holland	"
Wood, A. S	Bay City	"

FOURTEENTH ANNUAL REPORT

OF THE

EXPERIMENT STATION

OF THE

STATE AGRICULTURAL COLLEGE OF MICHIGAN

UNDER THE HATCH ACT

FOR THE

YEAR ENDING JUNE 30, 1901

For members and organization of the State Board of Agriculture in charge of the Station, and list of officers, see page 8 of this volume.

EXPERIMENT STATION.

REPORT OF SECRETARY AND TREASURER.

The following account shows the receipts and expenditures of the Experiment Station for the year ending June 30, 1901:

		Dr.	Cr.
July 1, 1900—To	balance on hand	$487 44	
July 5, 1900	received from U. S. Treasury	3,750 00	
Oct. 6, 1900	received from U. S. Treasury	3,750 00	
Jan. 5, 1901	received from U. S. Treasury	3,750 00	
April 3, 1901	received from U. S. Treasury	3,750 00	
June 30, 1901	license fees on 98 brands commercial fertilizers	1,960 00	
	miscellaneous receipts	246 10	
	farm receipts	1,516 07	
	miscellaneous receipts, South Haven	384 34	
	from State appropriation for U. P. Experiment Station	4,122 95	
June 30, 1901—By	disbursements as per vouchers filed in the office of the State Auditor General		$23,100 75
July 1, 1901	balance on hand		616 15
		$23,716 90	$23,716 90

From thirty-five to forty thousand copies of station bulletins are now issued, and the demand is increasing as farmers learn of their value. Several press bulletins have been issued and special information in bulletin form has been sent out by the station.

DISBURSEMENTS ON ACCOUNT OF U. S. APPROPRIATION.

Salaries:		
Assistants to scientific staff, No. employed 4	$1,605 60	
Director and administrative officers, No. employed 6	1,986 80	
Scientific staff, No. employed 7	4,771 50	
		$8,363 90
Labor:		
Monthly employes, 2; average rate, $22.50	$540 00	
Daily and hourly employes	1,572 28	
		2,112 28
Chemical supplies:		
Chemicals		139 57
Half tones, mailing list, etc	$109 69	
Bulletin envelopes and reports	418 77	
		528 46
Carried forward		$11,144 21

Brought forward		$11,144 21
Seeds, plants and sundry supplies:		
Agricultural	$189 19	
Horticultural	108 82	
Miscellaneous	82 08	
		380 09
Tools, implements and machinery:		
Repairs	$10 61	
New purchases	25 10	
		35 71
Furniture and fixtures:		
One typewriter	$70 00	
One card catalog case	36 50	
Sundry fixtures, three tables	9 00	
		115 50
Scientific apparatus:		
One pony premo camera outfit	$41 03	
One polariscope	93 46	
Sundry items	585 71	
		720 20
Live stock:		
Cattle	$1,151 18	
Swine	108 23	
		1,259 41
Traveling expenses:		
In supervision of station work		203 06
Building and repairs		135 40
Postage and stationery		330 01
Freight and express		181 05
Fertilizers		27 65
Feeding stuffs		135 17
Library		332 54
Total		$15,000 00

DISBURSEMENTS OF EXPERIMENT STATION—MONEYS OTHER THAN RECEIVED FROM UNITED STATES TREASURER.

Salaries	$744 11	
Labor	3,044 06	
Postage and stationery	73 10	
Freight and express	6 15	
Chemical	91 90	
Seeds, plants and sundry supplies	1,348 46	
Library	5 00	
Tools, implements and machinery	32 07	
Scientific apparatus	26 40	
Building and repairs	2,370 19	
Traveling expenses	359 31	
		$8,100 75
Balance on hand		616 15
Total		$8,716 90

REPORT OF THE DIRECTOR.

There have been issued in the year ending June 30, 1901, the following bulletins:

No.	Title.	Author.	Department.	Pages.
185	Fertilizer Analyses	R. C. Kedzie	Chemical	13
186	First Report, Upper Peninsula Experiment Station	C. D. Smith and others	....	45
187	Report of South Haven Sub-station	S. H. Fulton	Horticultural	47
188	Experiments with Sugar Beets	J. D. Towar	Agricultural	13
189	Notes on Strawberries	L. R. Taft and M. L. Dean	Horticultural	12
190	Vegetable Tests for 1900	L. R. Taft and M. L. Dean	Horticultural	36
191	Shrinkage of Farm Products	C. D. Smith	Agricultural	....
192	Fertilizer Analyses	R. C. Kedzie	Chemical	....

One special bulletin has been issued in the same period, making the fourteenth in that series. It was entitled "Foul Brood" and was written by Mr. John M. Rankin, the Station Apiarist.

I submit, herewith, copies of the bulletins mentioned, with the reports of the heads of the various divisions. These reports and bulletins will give a complete and accurate idea of the work of the station during the year. It hardly seems wise or necessary, therefore, for me to go over the work in detail.

The Agriculturist has carried forward the investigations relating to sugar beets, reaching results in the matter of fertilizers of extreme value to Michigan farmers, and conducting other experiments not yet concluded concerning other phases of the work that must produce results of equal importance. Capital is still flowing into Michigan for investment in sugar factories. It seems important, therefore, to the Station to continue these investigations on a more extended scale. In pursuance of this policy, with the consent of the State Board and by the courtesy of the Farm Department of the College, five acres of beets have been planted in the spring of 1901, on the west part of field No. 12.

In connection with the sugar beet business an important matter is the disposal of the beet pulp. But very little of this valuable cattle feed is at present utilized. It remains in large, rapidly decaying piles close to the factories, and becoming a nuisance, if not a menace to health. Because hay and grain are comparatively cheap in this country it is hardly to be expected that beet pulp will come into general use as quickly as it did in Germany, where cattle foods are all high. Moreover, as the pulp comes from the factory there are never more than ten pounds of actual feeding material in one hundred pounds of the product. The transportation cost is therefore very heavy, when compared with the efficient feed obtained. No question, therefore, is of more importance as far as the work of the Station is concerned than those relating to the feeding of beet pulp. Some tests were made during the winter of 1900-1901, but the results are not at all conclusive. At

Alma the steers made a very substantial gain on the pulp ration and returned a good money value for the pulp consumed. In the western part of the State, on the farm of the Honorable A. M. Todd, another bunch of steers were fed to test the value of pulp, but the work was unsatisfactory, as far as showing any value to the dry matter of the pulp. At the home Station, with milk cows, the question was tested a couple of years ago without showing any appreciable increase of milk or butter when the pulp was added to the ration. The work will need to be done over more than once more before reliable pronouncement can be made by the Station.

The Agriculturist finds an opportunity of helping farmers living on sandy soils by finding a new legume to take the place of clover, or, rather, to take the place on sandy soil occupied by clover on clays and clay loams. Such a legume is sand lucerne. He is also testing cow peas and soja beans for use with corn in the silo or field cured to enrich the ration in protein without the purchase of commercial feeding stuffs.

As the State grows older, commercial feeding stuffs are coming more and more into use. Neither farmers nor city owners of live stock can determine the real value of a given sample of feeding material by ocular or any other examination. Different samples of the same kind of material differ widely in composition and feeding value. In other states these commercial feeding stuffs are analyzed and the results published in bulletin form at the expense of the State. So imperative is the demand for this work in Michigan that the chemist proposes to collect various samples from widely different parts of the State, but representing on the whole the kinds of materials actually sold here, analyze them, and report the results of analysis in bulletin form. This kind of work is now done with commercial fertilizers, and incalculable good to the State results.

The season's work in the Upper Peninsula resulted in excellent crops of vegetables and cereals. On the first of May the Station grounds were an unbroken forest. In October the ground had been cleared and had produced abundant crops. The history of the work was published in Bulletin 186, which was scattered broadcast over the State and sent, as well, to prominent newspapers which called for it. The information was thus scattered to all parts of the Union and the Experiment Station in the first year of its history cannot fail to have attracted wide-spread attention to the agricultural possibilities of the Upper Peninsula.

The funds having been provided by the Legislature, a suitable house and barn were erected in the fall of 1900. The cleared land has been fenced, and preparation made for the introduction of stock and for the carrying forward of farming operations in a practical way after a sufficient area has been cleared for pasture.

The fruit orchards at South Haven are now in full bearing. The yields of different varieties of peaches will therefore begin to give some indication of their relative value. The same is true of other species of tree fruits. A large part of the work heretofore done at that Sub-Station has of necessity been preparatory, as it takes many years to develop trees, and obtain a sufficient number of crops to indicate anything about its productiveness or the quality of the fruit.

The mailing list is increasing by leaps and bounds, and now exceeds thirty thousand names on the regular permanent list. Within two years the names have been gone over carefully and such names as do not represent actual living citizens have been dropped. Through the Institutes and the addresses of members of the College faculty the people of the State are becoming well acquainted with the Station, and receive our publications. This wide acquaintance brings in its train a voluminous correspondence to every member of the staff. It is not wide of the mark to say that as far as immediate effects are concerned the Station benefits Michigan farmers almost as much through answers to questions as through the bulletins themselves.

It naturally follows from a wide correspondence that experts from the Experiment Station are called to furnish information about insects and fungus diseases of plants, about diseases of live stock, and, in fact, along all lines of farm work. So widely is the value of this expert assistance appreciated that the railroads carry the Director of the Station free over their lines, and the Pere Marquette railroad goes still farther and grants a pass, which carries members of the Station staff to any point on their line. The thanks of the Board, of the members of the staff, and of the people of the State at large are due the railroads for their generosity in this respect.

C. D. SMITH,
Director.

Agricultural College, Mich.
June 30, 1901.

REPORT OF THE AGRICULTURIST.

Prof. Clinton D. Smith, Director of Experiment Station:

Dear Sir—I herewith submit the report of the Agricultural Field Experiments for the year ending June 30, 1901:

The work of the Department for the past year has been largely along the lines begun in previous years. The co-operative soil test experiments with fertilizers, have been terminated, giving results largely of a negative character.

The remote location of these experiments from the Central Station, the traveling expense and the larger amount of the time of the Agriculturists given in installing and visiting the experiments and harvesting and weighing the crops are serious obstacles in the way of successfully and satisfactorily prosecuting such tests. Then, too, it is difficult to find farmers who can devote the time to give such work the complete attention it demands. Not only is it difficult for them to devote the time, but their large fields, herds and flocks giving continual promise of money returns, detract from the interest offered by a few square rods where the only return will be a handful of products and the lesson of the experiment; other farm work often claims the attention of all the help when the experimental plot is most in need of a little attention.

The Agriculturist visited Mr. A. E. Gregory's field, near Dowagiac, in September, only to find that practically nothing had been done there since the seeds were planted. All hope of securing any results of value was at once dispelled and the experiment abandoned.

Mr. H. M. Kingsley's experiment, at Kendall, Van Buren county, was, in 1900, conducted on a new piece of land of a sandy loam nature. The entire area was sown to sugar beets and throughout the conduct of the experiment, from the preparation of the soil to the weighing of the crop it was conducted in the most careful and painstaking manner.

Below is a table showing the complete results. The area of the plots was 1-10 acre each, being 16 rods long, east and west, and one rod wide, with 3-ft. paths between. The beets were sown in drills two feet apart, lengthwise of the plots and the paths sown to carrots.

H. M. Kingsley Experiment. Kendall, Van Buren County.

Number.	Fertilizer applied.	Pounds per acre.	Yield per acre. Pounds.	Weight of sample tested. Ounces.	Per cent sugar.	Coef. purity.
1	Nitrate of Soda	120	12,960	17⅓	8.36	67.37
2	Dissolved Phosphate Rock	240	10,330	17⅓	11.93	77.42
3	Muriate of Potash	120	12,400	22½	9.28	67.69
4	Nothing	....	8,960	11⅞	10.98	70.79
5	Nitrate of soda, 120 Dissolved Phosphate Rock, 240	360	10,900	22½	10.68	73.60
6	Nitrate of Soda, 120 Muriate of Potash, 120	240	14,100	27½	9.34	71.24
7	Dissolved Phosphate Rock, 240 Muriate of Potash, 120	360	9,700	13½	8.32	70.45
8	Nothing	....	7,900	22¼	10.78	75.86
9	Nitrate of Soda, 120 Dissolved Phosphate Rock, 240 Muriate of Potash, 120	480	14,900	19¾	9.61	72.20
10	Air-Slaked Lime	2,000	9,500	21⅛	9 80	71.48

Mr. Kingsley sold his beets to the Kalamazoo Beet Sugar Co. The beets tested 10.7 per cent sugar, making the price $4.06⅔ per ton, with a tare of 9 per cent.

The above figures show decidedly increased yields where fertilizers were applied. Nitrogen seeming to be most lacking, followed closely by potash. There is a slightly increased yield over the nothing plots where lime was applied.

Why the yield and per cent of sugar were not higher is a question that neither Mr. Kingsley nor the writer are able to explain. Mr. C. M. Kingsley, on an adjoining farm, obtained 10 tons per acre with analyses of four acres of beets, showing average of 12.82 per cent sugar.

SOIL TEST ON MUCK LAND.

The tests on the muck land in the College Field No. 13, on the farms of C. R. Ferguson and Darius Allen, near Almont, Lapeer county, on Mr. A. M. Todd's farm, at Pearle, Allegan county, and on Brook Farm of the Michigan Asylum for the Insane, at Kalamazoo, were conducted through last season and are being continued again this year. At Pearle, an unfavorable season practically destroyed the entire experiment. Mr. Todd has, however, lowered the ditches in the vicinity of the experimental plots and we look for more indicative results this year. The beets grown on this muck land in 1900, gave a higher per cent of sugar than we have had before from similar soil.

The Ferguson and Allen experiment gave in its preliminary returns some results pointing to general exhaustion, though more particularly to a deficiency of the mineral elements. The experiment will be watched the coming year with greater interest in the hope of drawing some definite conclusions.

The Michigan Asylum farm, at Kalamazoo, is probably in better natural condition than either of the other farms and therefore does not respond so readily to applications of materials intended to add to its store of plant food or its physical condition.

In field No. 13 of the College farm, about two acres have been fenced off and used for experimental work the past three years. These results have proven very satisfactory, and thus far point to wood ashes, barnyard manure, and upland soil as the best applications to make for the improvement of this land. Here and in all the other muck experiments, we have noticed in particular the indifferent effects of the action of lime. The litmus test has shown a practically neutral condition, while in one place on the College farm, a small quantity of marl was plowed up two years ago. This latter fact would indicate a sufficiency in the supply of calcium and if there is no acid condition to correct, the lime could be of but little use. The entire report of the two years' experiments will appear in bulletin form at the end of the present season.

TESTING VARIETIES.

Wheat.—In the fall of 1900 the following press bulletin appeared, giving the result of our tests of varieties of wheat and a general formula for the use of formalin and hot water as a preventive of smut:

Press Bulletin No. 15.—Remedy for Smut in Wheat.

Formalin Treatment.—Take one pound or pint of formalin—the druggist may call it 40 per cent formaldehyde—and stir it into 50 gallons of water. This quantity will treat 50 or 60 bushels of wheat. If a smaller quantity is required less amounts may be used, by keeping the same proportions, which are practically an ounce of formalin to three gallons of water. The cost of formalin in small quantities is about five cents an ounce.

Sweep clean a place on the barn floor and sprinkle well with the formalin solution. Put the seed wheat on this sprinkled area and sprinkle or spray the wheat with the formalin solution and shovel it over until every kernel is thoroughly wet. Do not be satisfied with simply dampening the grain but apply the solution until every kernel is visibly coated with water. Allowing it to stand in a compact pile a couple of hours will insure the more complete action of the formalin. If the grain is to be sown broadcast by hand at once it need not be thoroughly dried before sowing. But if it is to be kept long before sowing, or is to be sown with a grain drill, a certain degree of caution which every farmer will understand, must be exercised to dry it thoroughly so that it will not sprout and spoil nor be too wet to work well in the grain drill. In drying the grain and handling it afterward care should be taken to wet the floor, utensils, bags, etc., with the formalin solution so as to kill every trace of the smut on the things with which the treated seed is to come in contact.

The above treatment is inexpensive and simple to apply. We have never heard of a case where it has failed to work.

Hot Water Treatment.—The following treatment has been used for years, and if carefully applied is practically sure. It is, however, more cumbersome and laborious than the formalin method though the expense for material may be a little less.

Soak the seed wheat for ten minutes in water at 133 degrees F. Use a tested thermometer only. Provide two vessels large enough to hold twenty gallons each, if possible. One should contain warm water at about 120 degrees F., the other scalding water at 133 degrees. Into the first vessel plunge the seed wheat in a burlaps sack or wire basket. Keep it there until warm, then plunge into the second vessel, lifting it out occasionally and shifting it about in the scalding water until every kernel has been exposed to the temperature. Remove from the second vessel, at the end of ten minutes, and cool immediately, either by spreading on a clean floor in a thin layer or plunging into a barrel of cold water. Dry and sow, or sow broadcast at once.

Seed once treated successfully by either of the above methods will grow smut-free grain for a number of years. In fact, if every farmer in the State would treat his seed wheat carefully this fall and keep smutted wheat from coming into the State, there is no reason why we should ever be troubled again with this pest.

Variety Tests.—The table below gives the results of our field trials of varieties for 1900 and the average for 1899 and 1900 of those varieties which were grown both years. The 1899 yields were obtained from plots of nearly an acre or more. The 1900 yields are from one-tenth acre plots of summer fallow, liberally treated with a commercial fertilizer. The seeding of all the varieties, except Marshall's Triumph, was done Sept. 29 and 30. The Marshall's Triumph was not sown until Oct. 5.

None of the varieties entirely escaped the attacks of the Hessian Fly, although the Dawson Golden Chaff stood up the best of all at the time of harvest, the other varieties being about equally affected. The Winter Fife seemed to be the least affected by the fly, but this variety was not sown until Oct. 7.

Names of varieties.	Yield in 1900, per acre.	‡Average, 1899 and 1900, per acre.	Color of wheat.	Discription.
*Dawson Golden Chaff	32.73	32.64	White	Bald Red Chaff.
Gold Coin	30.75	31.42	“	“ “ “
International, No. 6	29 29	30.60	“	“ “ “
Jones' Longberry	27.50	....	“	Bearded Red Chaff.
White Clauson	27.92	26.	“	Bald “ “
Long Amber	24 17	21.10	“	“ White “
Jones Square Head	32.25	29.58	“	“ “ “
Harvest Queen	29.54	....	“	“ “ “
Early Genesee Giant	30.50	....	“	Bearded Red “
Hybrid Beechwood	26.25	....	Red	Bald “ “
Poole	32.33	....	“	“ “ “
Harvest King	26.42	....	“	“ “ “
Fultzo-Mediterranean	27.75	....	“	“ White “
Russian	28.00	28.95	“	Bearded “ “
Buda Pesth	29.66	25.59	“	“ “ “
Fulcaster	19.42	23.72	White	Bald “ “
†Marshall's Triumph	22.	....	“	“ “ “

* Average of four plots.
† Sown Oct. 5.
‡ Yields in 1899 are found in Bulletin 181.

In addition to the above varieties Early Arcadian, Earle's Velvet Chaff, Plymouth Rock, Red Clauson, Rudy, Currell, Winter Fife and a new Russian variety were grown. The first three named made very satisfactory growth, but the area was too small to give reliable figures of yields for acre areas. A portion of the plots of the other varieties was winter killed, though the Rudy, Red Clauson and Russian varieties made growths on the higher portions of the plots that would compare favorably with the best yielding varieties. The Winter Fife is a new red bearded variety, donated by Northrup, King & Co., of Minneapolis, Minn., but was received so late that a satisfactory crop was impossible.

All the varieties in the list above, together with a few new varieties, are being grown again this year.

Twenty varieties are being tried to determine their relative ability in resisting the attacks of the Hessian Fly. This experiment also includes the question of the proper date of sowing, by sowing the seed at intervals of ten days each from Sept. 1 to Oct. 21. The following varieties of wheat are being used in this experiment:

Hungarian, Russian No. 2,791, Buda Pesth, Russian, Dawson, Golden Chaff, Gold Coin No. 6, Poole, Jones' Longberry, Jones' Square Head, White Clauson, Harvest Queen, Harvest King, Fultzo-Mediterranean, Red Clauson, Hybird Beechwood, Early Genesee Giant, Marshall's Triumph, Rudy and Farmer's Trust.

Thus far the Oct. 1 seeding is by far the best. The Sept. 1 seeding made a fair growth last fall, but was practically all destroyed by the Hessian Fly. The Sept. 11 seeding gives promise of but little more than the Sept. 1, while the Sept. 21 seeding may be called one-third of a normal crop. The later seedings, Oct. 11 and 21, escaped the fall attack of the Hessian Fly, but did not get sufficient growth before winter to give them the necessary vigor in the spring.

There were four European varieties, one Hungarian, one Buda Pesth and two Russian. These varieties seemed to resist the fall attack of the fly better than the native sorts, though the insect has apparently worked on them this spring fully as much as on the others.

It is hoped to continue this experiment for several years.

Oats.—In 1900 seven varieties of oats were grown in comparative test with the following result:

Name of variety.	Weight per bushel.	Yields per acre.	
		Bushels by measure	Bushels by weight.
Scottish Chief	32	56.55	56.55
Brown's American Banner	33	61.48	63.40
Big Four	34	63.72	67.70
American Banner	32	65.54	65.54
R. I. Red Rust Proof	33	62.91	64.87
Michigan Wonder	32½	54.80	55.65
Black Russian	31½	49.65	48.25

The seed of the Black Russian and Big Four came from a Kansas seed house and had not been treated for smut. The Black Russian was badly smutted, which fact may account for its light weight and low yield. The Big Four had some smut, while the other five varieties were practically free from it. The Scottish Chief, Michigan Wonder, American Banner and Brown's American Banner were given the hot water treatment for smut three years ago—this being the fourth crop since the treatment and scarcely a trace of smut appeared.

The R. I. Red Rust Proof came from seed presented by Mr. A. A. Smith, of Woonsocket, R. I., who claims that this variety has been grown there for years and that it resists the attacks of the rust fungus. Since practically no rust appeared on any of the above varieties, we are unable to make comparisons in this direction.

Trials of the formalin and other treatments for oat smut have been made for the past three years with indifferent and inconclusive results. Each trial was made by using smutted seed, but in no case has the resulting crop shown the presence of any considerable quantity of smut from the untreated seed, and the yields have shown neither gain nor loss from the several treatments.

The variety test is in progress this year and all the seed sown has received the formalin treatment for smut.

Barley.—The department is testing several varieties of barley, both from seed purchased from seedsmen and seed imported by the Department of Agriculture at Washington.

Alinit.—A quantity of this material received from Farbenfabriken, of Elberfeld Company, New York, has been applied to oats and corn and planted in comparison with untreated seed. The trial is being made in four localities, namely: Sandy soil, dark loam, sandy loam and muck. It is, of course, too early yet to note any positive results.

Hops.—Seven imported varieties of hops are being grown for the Department of Agriculture at Washington.

Clover Experiments.—As noted one year ago a trial to determine the best time to sow clover seed had been begun. The experiment is now in the third year of its progress, and has furnished some interesting results. The seedings of April, May and June, 1899, gave 4,250, 3,900 and 4,950 cured hay, respectively, per acre in 1900. It should be noted that the June seeding was by mistake Mammoth Clover, the others are June Clover. This year, 1901, every plot sown before July 25, 1900, promises a good crop of clover hay. There are marked differences in the quantity of June grass and timothy appearing on the various seedings, which are being carefully noted for the bulletin to appear later. It is planned to carry each plot through two harvests of hay and continue the entire experiment through a series of at least five years, taking notes at frequent intervals and keeping records of the crops produced.

Co-operative Clover Seeding Experiment With the U. S. Department of Agriculture.—In accordance with an agreement made with the Division of Botany a co-operative test of clover seeds from various sources is being made. The seed from 18 different sources was sown in duplicate 1-80-acre plots. The results to be published as co-operative tests. Several lucernes and clovers from Europe, of our own importation, are being tried in comparison also.

Sugar Beets.—The growing interest in this crop in Michigan has kept the Department continually on the lookout for the new questions likely to arise in its connection. The experiments of 1900 have been published in Bulletin 188.

This year, 1901, we are testing the date of planting, distance apart of the rows, hill and continuous row planting, various quantities of seed per acre, comparative varieties, fertilizers in their effect on tonnage and per cent of sugar, seed of various ages, soaking seed before planting and the growing of beets on muck land. In 1900 a small quantity of seed was matured from tested beets and the same is this year sown to produce another crop. A few beets are being grown from seed sown in November, 1900.

There is now a sugar factory in the process of erection at Lansing, for which the Experiment Station is raising, in addition to the five acres distributed among its various plot experiments, another five acres in Field No. 12 of the College Farm. Incidentally we are conducting a fertilizer test here and growing the beets in rows of different distances apart.

Winter or Sand Vetch, vicia villosa.—This legume has given some very interesting results and is calling for more attention than before among stockmen. Its ability to grow from fall seeding and produce a crop of hay the next spring, especially recommends it as a forage crop.

In the fall of 1899 several sowings were made with a view of growing this legume for hay the following season. One lot sown September 5 was used for early soiling, beginning June 11 and continuing two weeks, during which time 1-10 of an acre produced 1,676 pounds of green feed. Another plot sown September 5 on light sand, was on June 11, cut for hay, producing one crop of 4,188 pounds cured hay per acre.

Another seeding was made October 5 at the rate of 3 pecks to the acre, using 3 parts Gold Coin wheat and 2 parts winter vetch. This was harvested June 25, producing 3,016 pounds of cured hay per acre.

Another seeding of 1 peck wheat and 1 peck vetch per acre, made October 7, 1900, on sandy loam soil in the experiment field, was harvested June 22, 1901, producing 4,300 pounds of cured hay per acre.

Another similar mixture on a loam soil in No. 6 produced on the same date 4,000 pounds of cured hay per acre.

These results recommend to us a new legume which can be sown late in the fall after one has had time to judge the prospects of his next season's clover crop, and give him a crop of hay the next season.

The Department has distributed a number of samples of seed of this legume and hopes to receive reports from them this season.

Sand Lucerne, medicago media.—Complete notes to date in regard to this remarkable legume were given in Bulletin 181, published in April, 1900. Since that bulletin was published the following in connection with the origin of sand lucerne has been received from The Wernich Seed Co., Milwaukee, Wisconsin, who imported the seed used in our experiments.

"Botanically, it is known as medicago falcata-sativa or medicago media. Dr. Edwin Birnbaum, Director of the Agricultural College, at Liegnitz, Germany, in his book on Meadows, Pastures and Fodder Plants describes it as a bastard, cultivated in many localities of Europe as a clover for sandy soils. Will do well on any other soil. In growth it is about half way between lucerne and Swedish alfalfa (medicago falcata). Its peculiarity is that it will vary sometimes in the bloom, the flowers sometimes being yellow, green, blue, violet and their various shades. Its growth the first year is very tardy. Once started it will yield 3 or more crops a year. It is very slow in starting in the spring, but seeding on the contrary should be very early, so that seed gets the benefit of plenty of moisture. In extreme cases of drought-suffering localities it should be sown with grain, but the latter is not to be left to ripen or it will smother the small plant.

"Its feeding quality is not as good as that of the ordinary lucerne, but it has the advantage over the latter that it does not bloat cattle as easily. It also stands pasturage better than lucerne."

In the summer of 1900 a 1-10-acre plot was used to test its value as a pasture crop; both as to its food value and its ability to withstand frequent grazing and the tramping of the animal's feet. A movable pen 16 feet long and 8 feet wide was, on May 1, started at one end of the plot, which was 1 rod by 16, and moved each day at a rate sufficient to pass over the entire area four times in 5 months. Until July 1 a dorset ewe and two lambs were kept in the pen, then the ewe was removed and the lambs left there alone. Up to August 15 the lambs gained constantly and had increased 82 pounds in weight. They received in addition to the lucerne pasture 1 pint of oats daily. After August 15 the lambs continued to fall off in condition and weight. Had the experiment been a feeding experiment only it would have been policy to remove the lambs at this time and give them a change of feed, but in order to further test the vigor of the lucerne under continued pasturage and learn, if possible, its injurious effects upon the lambs, they were continued in the experiment until October 1, when one of the lambs died, followed a few days later by the other.

The conclusions are that the crop will furnish abundant pasture and that pasturing is not injurious to the crop as evidenced by the complete growth that has appeared again this year. Perhaps it will be necessary to avoid making it the entire ration for animals during the fall when the natural food is of a less succulent nature.

Another plot was cut for hay, giving four crops in 1900, as follows:

June 11	4,223 pounds cured hay per acre
July 12	3,828 pounds cured hay per acre
August 22	2,904 pounds cured hay per acre
October 1	1,355 pounds cured hay per acre
Total	12,310 pounds cured hay per acre

This plot has produced this year, one crop cut June 15, amounting to 4,265 pounds of cured hay to the acre, and at this writing, June 29, the second growth is 12 inches high.

For light, sandy soil, on which red clover furnishes but one cutting and the Bromus Inermis dries up entirely in the late summer, these figures seem quite remarkable. Large areas are now devoted to this crop and a portion this year will be allowed to grow to seed.

In the spring of 1900 the department mailed 135 six-ounce packets of sand lucerne seed to farmers in the State, whose addresses the writer collected at farmers' institutes. Reports are now being received from these farmers and the same will probably be compiled into bulletin form during the coming fall.

The Curiosity Strip.—This strip of one acre of the experimental ground was, before the college course was changed, putting the long vacation in the summer, largely used as an experimental ground in the hands of the agricultural students. With the change of the college course and lack of suitable space for other experimental work, the original object of the curiosity strip has been somewhat modified, yet it continues to be the starting ground of many new plants and prospective experiments. The east end has been, in past years, occupied by perennials, many of which have run out and become unattractive. The present year this strip is planted to numerous new legumes, corn and legume combinations for forage.

The Hessian Fly experiment with wheat, sugar beets from home grown seed, and new seeds and plants received from various sources in quantities too small for field trials.

ACKNOWLEDGMENTS.

The Department takes pleasure in acknowledging with thanks the receipt of the following articles, which have proven very beneficial in our work:

One ton of nitrate of soda from The Propaganda for Nitrate of Soda, New York city; One ton German potash salts from the German Kali Works, New York city. One ton acid phosphate from the Armour Fertilizer Works, Chicago, Ill. One subsoil plow from B. F. Avery & Son, Louisville, Kentucky. One Bacon drill from the Central Implement Co., Lansing, Mich.

During the past winter about nine weeks of the time of the Agriculturist was consumed in attending farmers' institutes.

Respectfully submitted,
J. D. TOWAR, *Agriculturist.*

Agricultural College, Mich.
June 30, 1901.

REPORT OF THE HORTICULTURIST.

To the Director:

The following report for the past year furnishes an outline of the work that has been done by the department, and the present condition of the experimental work that is under way.

In the spring of 1900 all of the trees in the station orchards at the college, that seemed to be severely injured by the winter of 1898-9, were removed and young trees set in their places, but when the spring of 1901 opened it was found that many more, and especially the older trees in the case of the cherry and peach, were in a dying condition. These also were removed and the vacancies were filled either with trees of new varieties, or with strong-growing standard kinds to be used for top-working.

Many of the young trees bore their first crop last year and still others have set fruit this spring, so that a large proportion of the trees in the new orchards have produced fruit. The conditions at the time of flowering, and during much of the time since that date, have not been favorable for the setting and development of fruit, and in nearly all cases the crop will be a light one.

The trees have been quite free from the attack of dangerous insects and plant diseases. Last spring a single young plum tree was found to be infested with San Jose scale. It was at once destroyed, and although the neighboring trees were apparently free from attack, as a safeguard, all of the trees in the block were sprayed with a ten per cent mechanical emulsion of refined kerosene.

EXPERIMENTAL WORK WITH VEGETABLES.

In addition to testing many of the novelties in vegetables, considerable attention was paid to the trying of various methods of trellising the tomato and observing the results upon the earliness and productiveness of the plants, and upon the appearance and quality of the crop. For early crops, the best results are secured by training to stakes and the removal of the branches as soon as the shoots start. In unfavorable seasons the yield will usually be larger than when the vines rest upon the ground, especially as the upright training of the plants makes it possible to use fully twice the number of plants. The color and flavor of the fruit are also greatly improved.

An elaborate experiment with various fertilizers was carried on upon two acres of leased land north of the college, with potatoes. The results have already been published. Although the land appeared very uniform, the results varied to such an extent that it was not possible to draw any reliable deductions from them. In a majority of the plots fertilized with chemicals, the cost, in proportion to the crop, was greater than when stable manure was used, the latter being reckoned at one dollar per load when spread upon the land.

Considerable attention was also paid to the subject of cover crops for orchards. A nine year old orchard was cultivated at frequent intervals up to the middle of August, when it was divided into tenth acre plots, which were sown to the following cover crops: (1) crimson clover, (2) crimson clover and oats, (3) oats, (4) rape, (5) rape and crimson clover, (6) rape and oats, (7) flat turnips and (8) flat turnips and oats.

A fair stand was secured with all of them and a good growth was made during the fall. All except the crimson clover were killed down during the winter and this was turned under about the middle of May, before the ground had become dry. The winter and spring were unusually favorable for this crop, as it is generally more or less injured in the winter and it seldom happens that the weather in the spring is sufficiently moist to make it safe to delay plowing until May 15, as was the case this spring. Like rye and other winter crops, considerable harm is often done by leaving crimson clover until it has blossomed. Especially upon heavy soil, it causes the land to dry out and bake, so that the injury to the growth of the trees is greater than the benefit from the increased growth of the clover.

Of the crops tested, clover is the only one that returns to the soil anything in the way of plant food that was not taken up from it by the crop itself, and even though the clover is not killed out by the winter, which has been the case one year in two, the amount secured will not be large. The oats grew to a height of from fifteen to eighteen inches and supplied a large amount of humus to the soil. They also served well the purpose of holding the snow and leaves and thus lessening the freezing and thawing of the soil, as well as the depth to which the frost could penetrate. While there are few soils that are not benefited by the replenishing of their humus, it is the effect of cover crops in lessening the injury from frost that is even more vital in its importance. When clover was sown with the oats, the results were less satisfactory as, when the oats were thick enough to be of any value themselves, or as a nurse crop for the clover, the catch of the clover was not as good as when it was sown alone. The same was true when the clover was sown with rape.

Rape and turnips furnished considerable fiber and the former was high enough to hold the snow, but they were rather unsightly and gave off an offensive odor during the winter.

A noticeable feature, when it came time to plow the land in the spring, was that the plots where oats were sown alone were very free from weeds and the ground remained moist considerably longer than where the other crops were used, making it possible to put off the working of the orchards in the spring considerably longer, besides lengthening the periods between the cultivations. In the spring, the oats are in such a condition that they can be dragged in with a disk harrow, and a plow will not be necessary. It is estimated that the cost of cultivating an orchard when a cover crop of oats is used, is fully one-third less than when crimson clover has been sown.

SPRAYING EXPERIMENTS.

For several seasons there has been considerable injury to apple orchards in various parts of the State from canker-worms and tent-caterpillars, both of which feed on the foliage during the early spring. The station orchards have been regularly sprayed for the last ten years and neither of the insects named have been found for some time, so that it has not been possible to illustrate the method of combatting them. Some years ago, however, both of them were to be found upon the trees and we were convinced that the remedy which was effective at that time and which, used as a preventive, has since kept them from regaining a foothold in the orchard, would be found equally effective in other orchards, although many to whom we recommended it reported that it was of no value. The treatment consisted of the thorough spraying of the trees with Paris green, or white arsenic. To prevent the burning of the foliage and their being washed off by the spring showers, it was recommended that either freshly slaked stone lime, or Bordeaux mixture, be added to the spraying compound. The use of the latter is desirable, as it will also aid in controlling the attack of fungous diseases. While a few reported partial or entire failure from the use of this spraying mixture, others found it to be an unqualified success.

To serve as an object lesson and to demonstrate that the insects mentioned above could be readily controlled, arrangements were made with C. E. Hadsell, of Troy, Mich., who had recently come into the possession of a seventeen acre apple orchard, some twenty-five years old, which had been badly infested with the tent-caterpillar, and in which the canker-worm had been at work for five years. In 1900, the worms had become so numerous that the trees in the center of the orchard looked as if burned with fire, while those at the east and west ends were considerably injured. Spraying was commenced in 1901, just before the opening of the blossoms and a second application was made soon after the blossoms dropped. While the trees were in bloom, and at the time of the second application, the larvæ were hatching and were numbered by the thousand upon single trees, but a careful examination on June 17 showed the orchard to be free from worms, and there was no indication in the appearance of the foliage that any harm had been done. At the same time all of the foliage upon unsprayed trees was found to be destroyed.

The arsenic was prepared by boiling one pound in two gallons of water with two pounds of lime for forty minutes, and then adding it to 250 gallons of Bordeaux mixture. There is of course nothing new in the fact that these insects can be controlled by spraying with arsenites, it having been demonstrated fully twenty years ago, and the failures that have been reported must be attributed to lack of thoroughness in spraying, or to putting it off so long that the larvæ were nearly full grown, when a large amount of poison would be required to kill them, and to obtain it they would have to eat enough of the leaves to nearly, if not quite, defoliate the trees. When two applications are made, at the times recommended above, and the work is done so thoroughly that every leaf is covered, it will be found a simple matter to control these insects.

Considerable work has also been done in the way of spraying experiments to control the leaf-curl of the peach. The importance of early spraying has again been demonstrated, and while the results from fall spraying do not seem quite as good as when the work is done after the middle of February, the results from single applications in November and December, after the leaves have fallen, have been very marked. Bordeaux mixture appears to be little if any more effectual than a solution of copper sulphate and up to the present time the trees sprayed with one pound in fifty gallons seem as free from the disease, as when one pound was dissolved in twenty-five gallons or less. When the trees are thoroughly sprayed in March or early April there has been no trouble from the disease.

OTHER EXPERIMENTS AT TROY.

The orchard that had been leased by Mr. Hadsell, having been comparatively unfruitful for a number of years, it was thought advisable to combine with the spraying experiment for the destruction of the canker-worm, various other operations that are considered important in the renovation of an old apple orchard. The trees had been fairly well pruned, but the land was in sod and the trees had neither been fertilized nor sprayed with fungicides. As mentioned above, Bordeaux mixture was applied to the trees sprayed with arsenic, and a portion of the orchard was plowed. To test the need, as well as the effect of plant food, plots were laid out across both the plowed and the unplowed land, and to these stable manure, wood ashes and various chemical fertilizers were applied. It is too early to judge of the effect of this treatment, but a marked benefit, judging from the results secured with fertilizers in the neighboring wheat field, may be expected.

SOUTH HAVEN SUB-STATION.

The work at the South Haven Sub-Station has remained in the hands of Mr. S. H. Fulton, who has carried it on in a very satisfactory manner.

Although some of the older peach trees still show the effects of the freeze of 1898-9, most of them are in excellent condition. The centers of all the old trees are blackened, but it is noticeable that where the ends of all the main branches were cut back to the extent of one year's growth in the spring of 1899, the trees have done much better than those that were left unpruned, or that were cut back about one-half of the previous year's growth, as they have usually been pruned. As compared with the unpruned trees, in particular, the annual rings of growth made during the last two years are very much thicker. The few trees that were cut back more than this have not done as well as those that were headed back to short stubs of the main branches have in many cases died.

Aside from the routine spraying of the orchards, considerable attention has been given to experimental spraying to determine more definitely the times at which the applications will be most effective, as well as the best strengths to use and the number of sprayings that can be profitably employed.

Numerous additions have been made to the number of varieties under trial, by gifts of trees and scions from various nurserymen and the National Department of Agriculture, as well as by purchase, so that the collection of varieties is very complete.

The crop secured in 1900 from trees old enough to bear was a good one, and notes upon the behavior of the different kinds were printed in the report presented by Mr. Fulton in December.

STATE FAIR AND EXPOSITIONS.

As in previous years, exhibits of fruit, both from the college and South Haven, were made at the State Fair in Grand Rapids last fall. Including walks, a space measuring nearly 800 square feet was occupied. This is nearly twice the space that has been secured in the horticultural building at the Pan-American exposition for the entire State. By placing the early varieties in cold storage as they ripened, it was possible to show all of the more valuable varieties of tree fruits that matured after the middle of August.

At the request of Col. G. B. Brackett, Chief of Horticulture for the United States at the Paris exposition, a collection of apples and pears obtained from the college and sub-station orchards was shipped to Paris about the middle of September. We had hoped to show one hundred varieties of apples and fifty of pears, but the injury from the severe wind and rain storm of the previous week was so great that but about two-thirds that number of varieties could be secured. The fruit reached Paris in good condition, although it was shipped as ordinary freight without cold storage, and was placed on the tables for the exhibition of October 10. A portion of it was also shown on October 24 and on both occasions received a gold medal diploma.

As the State had made no arrangements for an exhibit at Buffalo, no attempt was made to carry over the winter any of the fruit of the crop of 1900, but arrangements have been made with the Michigan State Pan-American Commission for a showing of fresh fruit as it ripens during the remainder of the season. Four cases of wax models of fruit were shipped to Buffalo May 1 and will remain on exhibition during the entire season.

INSTITUTES AND HORTICULTURAL MEETINGS.

During the summer of 1900, the writer attended a series of three one-day institutes in Alcona county. I was also present at the institutes at Charlotte and Concord. At the State Round-up at the college I had charge of the horticultural section and presented a paper on "Spraying Mixtures and Spraying." During the year I have attended the annual meeting of the Michigan State Horticultural Society at Grand Rapids, and its June meeting at Detroit. I was also present at the winter meetings of the Indiana State Horticultural Society at Indianapolis, and the Wisconsin State Horticultural Society at Oshkosh.

My assistant Mr. Dean also spent fully a month in institute during the winter.

ASSISTANTS.

My only regular assistant in experiment station work during the past year was Mr. M. L. Dean, who has had charge of much of the field work. Valuable assistance has also been rendered by several members of the class of 1901, who are making a specialty of horticulture. Among them are D. B. Jewell, R. S. Northrop and C. W. Haven. The former has looked after several of the vegetable crops, while Messrs. Haven and Northrop have divided their attention between the fruits and vegetables, upon which they took many of the notes.

Respectfully submitted,
L. R. TAFT,
Horticulturist.

AGRICULTURAL COLLEGE, MICH.
June 27, 1901.

REPORT OF THE CHEMIST OF THE EXPERIMENT STATION.

Prof. C. D. Smith, Director of the Experiment Station:

SIR—I submit herewith my report of the work done in this laboratory for the year ending June 30, 1901:

THE FIELD OF ITS OPERATIONS.

The normal work of this department of the Experiment Station lies in the investigation of chemical questions bearing on agriculture in its broad sense; the analysis of materials so related which may be submitted by the several departments of the college; the determination of the commercial value of the fertilizers, feeding stuffs, etc., offered for sale in the open markets, etc., so that the farmer, the fruit grower and stock-feeder may know the quality of these materials and their relative money value; and to co-operate in all movements to promote the great industries so far as they may be aided by chemistry.

Among these subjects the analysis of commercial fertilizers stands out prominently and the collection and analysis of commercial fertilizers and the publishing of the results thus secured in the form of a Fertilizer Bulletin, take up a large part of the time of this department. A similar investigation into the feeding-stuffs for the benefit of stock-feeders would seem to fall naturally into the hands of the Experiment Station. The work of this department in developing the sugar beet industry and the splendid results secured are good examples of this kind of work. The ways and means by which chemistry may aid agricultural production are matters of anxious inquiry on the part of the agricultural chemist.

SPECIAL LINES OF WORK.

1. Sugar beets. Four hundred analyses of sugar beets to determine sugar content, purity and estimation of *marc* have been made. Much of this work was performed for the Farm Department in determining the kind of soil suitable for sugar beets and the influence of fertilizers on the growth and value of the beets. Soils of different kinds and farms of different localities were used.

2. By products of beet sugar factory, e. g., the fertilizing value of lime-cake, molasses from the factory, and the beet pulp. These investigations were made to determine the recuperative value of these by products of the factory, in preventing exhaustion of the soil by cropping with sugar beets.

3. Samples of beet pulp from Alma, potato pulp from the starch factory at Traverse City and buckwheat middlings from Battle Creek.

4. Ten samples of feeding-stuff to determine the amount of protein or nitrogenous matter.

5. Eight samples of fertilizer from the Farm Department.

6. Four samples of ashes from Grand Rapids garbage plant for Horticultural Department.

7. Four samples of soil for Gov. Bliss.

8. Meteorological observations. For a period of 38 years tri-daily observations on the temperature, moisture, clouds, winds and rainfall have been taken at this college, these have been continued the past year.

9. Fertilizers and bulletins. The gathering in the open market of the specimens for analysis of all commercial fertilizers, the chemical analysis of the same, and publishing the results in a Fertilizer Bulletin, take up more of the time and work of the chemist of the station than any other subject. The license for the sale of such fertilizers for the year dates from the first of May, but it is difficult to secure a complete set of fertilizers at so early a date, and it often happens that the complete set cannot be found till the middle of June. We aim to issue the Fertilizer Bulletin by June 30, but it is often delayed for this reason, causing complaint of some persons.

The large demand for the Fertilizer Bulletin shows that the work of the Experiment Station in this line is appreciated.

The cordial relations existing between the soil-producers of every class and the Experiment Station of the Agricultural College are omens of good to all parties.

Respectfully submitted,
R. C. KEDZIE,
Chemist of Experiment Station.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

REPORT OF THE BACTERIOLOGIST AND HYGIENIST.

Director C. D. Smith:

Dear Sir—At the close of last year, I published in three bulletins all the experimental data which had accumulated to that date, preparatory to undertaking the investigation of a special milk problem. I have been exclusively concerned with this during the past year. It is not thought advisable to make public any of the evidence obtained because of its incompleted condition and also because of the possibility of misconstruction. Therefore I have no bulletin or report to issue other than this respecting my investigations.

Mr. S. F. Edwards has been engaged on some work which will be of interest when completed. This work he has been doing in conjunction with his other duties.

Besides the investigations which are in progress, many specimens have been received for determination and analysis. In this work much time has been consumed, but we trust profitably for those interested. Mr. Edwards has frequently and effectively assisted in these analyses.

Very respectfully submitted,

CHARLES E. MARSHALL.

Agricultural College, Mich.
June 30, 1901.

REPORT OF THE CONSULTING ENTOMOLOGIST.

Prof. C. D. Smith, Director:

Dear Sir—Following is a brief account of the work done by the Entomological Department of the Experiment station, during the year ending June 30, 1901.

During the year part of one bulletin (No. 186) was issued by this office. The correspondence has steadily increased, until, at the present time, it demands considerable time. A number of trips have been made to investigate questions bearing on the work of injurious insects. A trip was made to Pontiac, and one to Highland, for the purpose of demonstrating methods of fighting grasshoppers. At Highland, very thorough search was made for the eggs of grasshoppers, with the intention of finding out just where they were deposited; it was intended to recommend fall plowing in such places, but as very few eggs were really found, that plan had to be abandoned. Two trips were made to test the efficiency of a new remedy for the peach-borer and allied pests, one to Esther and one to South Haven.

A trip was made, in company with Professor Wheeler, to the substation at Chatham, in Alger county, upper peninsula. Collections of insects were made at the station grounds and in that vicinity, and, so far as possible, the insects collected were determined and listed, many records of importance being thus obtained. The more serious pests were selected and accounts of each given with measures for their destruction. These lists and accounts were published in Bulletin No. 186. Besides the work on insects, over thirty photographs were made of the growing crops, showing their condition in the field. On the way back, a stop was made at Beaver Island in Lake Michigan, where a brief survey of the same character was made.

The work on sugar-beet insects of the State has always been kept in mind, and all cases of injury to this crop have been given special attention, in order to gain as intimate an acquaintance as possible with the enemies of this new staple.

Several new scale-insects have been recorded from the State, all of considerable importance, and one old species, which was found some time ago, and which has become quite prominent in limited districts. Work on these pests is steadily going forward, in hopes of finding some new points that may be turned to account.

Many articles on insects and their control have been written for the agricultural periodicals and newspapers, where it seemed desirable to get information quickly before the public.

It is hoped that in the near future, a place may be provided for the study of noxious insects, such insects as scales, where they may be studied and experimented with in safety. It is not considered advisable to introduce such insects as San Jose scale or the European fruit-scale on our trees here for fear that they may become general. A small greenhouse would enable us to grow small trees in gauze cages in safety.

Such "insectaries" have been found very efficient in other states, and one could be used to great advantage here.

Respectfully submitted,
R. H. PETTIT,
Consulting Entomologist.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

REPORT OF CONSULTING VETERINARIAN.

Director C. D. Smith:

SIR—As Consulting Veterinarian for the Experiment Station, I have the honor to present the following report:

The greater part of my work for the past year as consulting veterinarian for the station, has been in replying to letters received relative to the diseases of live stock; nearly all these letters have referred to some sporatic disease and not to contagious disorders. A few have referred to contagious disorders and these have nearly all been sent to the State Veterinarian, conditions being such that they required the action of the Live Stock Sanitary Commission.

Those letters referring to the ordinary sporatic disorders, in all cases where the symptoms given would permit a diagnosis, were carefully answered; those letters where the symptoms given would not allow a diagnosis, the writers were referred to their local veterinarian. The great majority of the letters, however, have been received from localities where there were no qualified practitioners.

The sheep industry of the State is still suffering to a very great extent from certain diseases which are caused by internal parasites, the principal ones being the stomach disorder and nodular disease; if some effectual and easily administered remedy could be found which would destroy the parasites, it would be of great value to the sheep owners of the State.

Very respectfully submitted,
GEO. A. WATERMAN.

AGRICULTURAL COLLEGE, MICH.
June 25, 1901.

REPORT OF THE CONSULTING BOTANIST.

Prof. C. D. Smith, Director of Experiment Station:

DEAR SIR—The following report is a summary of the work of the Consulting Botanist of the Experiment Station for the year closing June 30, 1901:

The last two weeks in August were spent in making a preliminary examination of the soil and plant life of the new Upper Peninsula Experiment Station, located at Chatham. The results of the survey are published in the first report of the Upper Peninsula Experiment Station, Bulletin 186, issued in December, 1900. Considerable attention was devoted to the examination of sugar beets growing on the Experiment Station plots on the college farm during the summer of 1900. The leaf spot disease was quite prevalent, but seasonable rains following the early dry weather caused the beets to put forth new leaves which enabled them to store a good amount of sugar during the latter part of the season. Crown gall was occasionally seen, but caused little damage. Sun scorch also caused some trouble in certain plots. Beets which were stored in the root cellar at the college during the winter were found to be affected with heart rot, or dry rot, in the spring of 1901. Beet scab, a disease which appears to be the same as potato scab, was observed in some of the college fields.

The extreme cool weather during the latter part of May caused a "damping off" disease which threatened great destruction of seedling beets which had been planted early, in many parts of the State, but fortunately, however, the warm weather in June enabled the seedlings which were attacked to recover rapidly, in most cases.

Asparagus rust seems to be spreading throughout the State. The rust first appeared in the college garden this year. No experiments have yet been undertaken at the college to check the spread of this serious disease.

The testing of clover and grass seeds continues to increase each year, showing that farmers are becoming more careful to purchase better and cleaner seed, thus avoiding the spread of noxious weeds.

The numbers of weeds and others plants sent for determination has increased during the year past, as well as the general correspondence work.

Lectures in elementary botany have been given to short course students in horticulture and to the students in the sugar beet course.

Respectfully submitted,
C. F. WHEELER,
Consulting Botanist Experiment Station.

AGRICULTURAL COLLEGE, MICH.
June 30, 1901.

SUMMARY OF THE METEOROLOGICAL OBSERVATIONS AT THE MICHIGAN AGRICULTURAL COLLEGE EXPERIMENT STATION FOR THE YEAR 1900.

Months.	Mean daily temperature in open air.	Percentage of humidity, saturation—100.	Pressure of vapor of water in air.	Height of barometer reduced to temperature of 32° F.	Percentage of cloudiness.	Self-registering thermometers.		Amount of rain or melted snow in inches.	Snowfall in inches.	Number of thunder storms.
						Maximum.	Minimum.			
January	26.39	95.8	.147	29.085	63.2	31.9	19.2	1.17	3.60	0
February	18.83	97.8	.117	29.047	57.9	26.8	8.0	3.44	25.40	0
March	24.89	95.2	.136	29.104	47.7	34.5	12.7	1.88	12.90	0
April	48.43	83.1	.290	29.123	41.2	58.3	36.4	2.00	.90	1
May	60.01	85.1	.474	29.045	45.1	70.6	46.9	4.17	00	7
June	67.59	88.5	.603	29.064	26.2	77.6	52.7	2.57	00	5
July	70.73	87.7	.675	29.064	37.0	80.9	58.2	4.15	00	10
August	74.05	88.9	.757	29.119	35.9	85.0	61.7	2.98	00	6
September	65.31	88.5	.577	29.151	36.6	75.8	50.7	.87	00	4
October	57.12	89.9	.435	29.195	35.8	70.1	41.3	2.77	00	2
November	35.94	95.0	.215	29.093	62.9	42.9	27.2	4.52	11.70	3
December	27.69	96.2	.155	29.093	64.1	33.3	20.1	.50	2.60	0
Year	48.08	91.0	.382	29.099	46.1	57.3	36.3	31.02	47.10	38

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
M 1......	—2	12	18	9⅓	100	100	100	.040	.075	.098	28.817	28.905	28.990	28.904
T 2......	22	26	24	24	100	100	100	.118	.141	.129	28.820	28.889	29.009	28.906
W 3......	22	27	18	22⅓	100	100	100	.118	.147	.098	29.206	29.291	29.338	29.278
T 4......	22	35	34	30⅓	100	90	89	.118	.183	.175	29.218	29.211	29.204	29.211
F 5......	32	39	30	33⅔	100	91	100	.181	.216	.167	29.292	29.349	29.446	29.362
S 6......	30	36	29	31⅔	100	90	100	.167	.191	.160	29.484	29.471	29.381	29.445
S 7......	42	43	35	40	100	83	90	.267	.231	.183	29.133	29.069	29.255	29.152
M 8......	26	31	26	27⅔	87	89	100	.123	.155	.141	29.483	29.502	29.486	29.490
T 9......	24	43	41	36	100	75	100	.129	.209	.257	29.313	29.073	28.981	29.122
W 10......	29	28	23	26⅔	100	88	100	.160	.135	.123	29.176	29.207	29.220	29.201
T 11......	25	28	24	25⅔	100	100	100	.135	.153	.129	28.959	28.851	28.735	28.848
F 12......	28	30	28	28⅔	100	100	100	.153	.167	.153	28.899	28.954	29.013	28.956
S 13......	29	33	32	31⅓	88	100	100	.142	.188	.181	28.991	28.926	28.877	28.931
S 14......	34	36	34	34⅔	100	90	100	·196	.191	.196	28.854	29.048	29.196	29.033
M 15......	32	33	32	32⅓	100	100	100	.181	.188	.181	29.246	29.120	29.098	49.155
T 16......	30	33	31	31⅓	100	89	100	.167	.168	.174	29.350	29.366	29.418	29.378
W 17......	29	33	33	31⅔	100	100	100	.160	.188	.188	29.329	29.192	29.166	29.196
T 18......	34	35	34	34⅓	100	100	100	.196	.204	.196	29.137	29.126	29.166	29.143
F 19......	34	40	36	36⅔	100	100	100	.196	.248	.212	29.149	29.048	28.963	29.053
S 20......	33	38	32	34⅓	100	81	89	.188	.186	.162	28.707	28.818	29.003	28.849
S 21......	23	38	34	31⅔	100	72	89	.123	.165	.175	29.206	29.176	29.207	29.196
M 22......	31	46	37	38	100	69	90	.174	.215	.199	29.200	29.130	29.078	29.136
T 23......	34	34	26	31⅓	100	71	87	.196	.138	.123	29.071	29.199	29.346	29.205
W 24......	25	44	40	36⅓	87	76	82	.117	.218	.203	29.024	28.631	28.674	28.776
T 25......	32	21	11	21⅓	100	100	100	.181	.113	.071	28.785	28.977	29.073	28.945
F 26......	9	14	15	12⅔	100	100	100	.065	.082	.086	29.178	29.207	29.247	29.211
S 27......	10	23	25	19⅓	100	100	100	.068	.123	.135	29.204	29.018	28.908	29.043
S 28......	11	5	1	5⅔	79	100	100	.057	.055	.046	28.981	29.019	29.092	29.031
M 29......	1	12	13	8⅔	100	100	100	.046	.075	.078	29.041	28.860	28.767	28.889
T 30......	12	9	—1	6⅔	100	100	100	.075	.065	.042	28.639	28.725	28.803	28.723
W 31......	—4	9	6	3⅔	100	100	100	.036	.065	.057	28.805	28.823	28.929	28.852
Sums.....	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	26.39	98.1	92.1	97.3	.138	.157	.145	....	....	....	29.085
Average.	......	......	......	......	95.8			.147			....	....	....	....

JANUARY, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering Thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
10	Cir.	10	Cu.	100	St.	w	4	w	10	w	8	22	—2	8 p. m.	....	......	......
90	Cu.	90	Cir. Cu.	100	St.	s w	13	w	10	w	7	27	20	....	4 p. m.	.01	.10
100	St.	40	Cu.	....	....	w	5	w	4	w	5	27	17	....	....	......	......
90	Cir.St.	20	Cir.	90	St.	s w	8	s w	11	s w	11	35	22	....	....	......	......
60	Cir.	10	Cir.	20	Cir.	s w	5	w	....	w	....	41	20	....	....	......	......
100	Cir.St.	100	St.	100	St.	w	3	s w	....	s w	....	42	26	8 p. m.	....	......	......
100	St.	80	Cu.	....	....	s w	....	n w	16	n w	9	45	22	....	11 a. m.	.02	......
100	St.	10	Cir.	....	....	n w	3	n e	5	s e	8	31	23	....	....	......	......
20	Cir.	80	Cir.	100	Nim.	s e	7	s w	10	s w	10	43	24	3 p. m.	†	1.06	......
100	St.	10	Cir.	100	Cir.St.	n	5	n e	4	e	10	29	22	....	....	......	......
100	Nim.	100	St.	100	St.	e	5	n e	4	n e	3	29	23	....	....	......	......
100	St.	100	St.	100	St.	n w	3	n w	3	w	2	31	28	....	....	......	......
100	St.	100	St.	100	St.	s	7	s	8	s w	7	37	29	*	†	.11	1.10
100	St.	100	St.	100	St.	s w	6	n w	5	n e	....	37	30	....	....	......	......
100	St.	100	St.	100	St.	s e	3	e	2	n	2	34	30	‡	†	.48	1.50
100	St.	100	St.	100	St.	n	1	n	2	e	8	33	28	....	....	......	......
100	St.	100	St.	100	St.	e	11	s e	14	e	8	34	29	8:30 a.m.	12 m.	.01	......
100	Nim.	100	St.	100	St.	e	8	e	4	n	4	38	32	†	4 p. m.	.19	......
100	St.	100	St.	100	St.	n e	1	s	2	s w	3	40	32	....	....	......	......
100	St.	50	Cu.	10	St.	w	5	n	9	n	6	39	22	....	....	......	......
20	Cir.	10	Cir.	....	....	s w	3	s w	11	s	10	39	23	....	....	......	......
10	Cir.	10	Cir.	....	....	s	7	s	11	s w	11	47	30	....	....	......	......
100	Cir.St.	10	Cir.	....	....	n w	4	n	....	n e	....	40	19	....	....	......	......
100	St.	10	Cir.	....	....	s	17	s	16	w	8	47	24	§	7 p. m.	.20	......
100	St.	100	Cir.St.	....	....	w	8	n w	....	n w	9	32	8	‖	3 p. m.	.03	.30
40	Cum.	100	St.	90	St.	n w	8	n w	9	n w	....	15	9	Snow	flurries	......	......
20	Cir.	100	St.	....	....	s	....	s w	10	w	15	31	10	Snow	flurries	.01	.20
10	Cir.	80	Cir.	....	....	w	12	s w	15	s w	11	11	—1	Snow	flurries	.01	......
100	Cir.	60	Cir.St.	....	....	s w	9	s w	11	s w	13	20	1	....	....	......	......
60	Cir.St.	70	Cir. Cu.	....	....	s w	12	w	....	w	4	12	—10	†	4 p. m.	.04	.40
60	Cir.	30	Cir.	....	....	w	10	w	12	w	9	10	—4	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	......	......	....	....	1.17	3.60
77.1	....	63.9	....	48.7	....	....	....	....	....	....	....	31.9	19.2	....	....	......	......
63.2						....	....	....	....	....	....	......	......	....	....	......	......

* Snow 10:30 p. m. † In night. ‡ Snow 8 a. m. § Thunder 4:30 p. m. ‖ Snow in night

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
T 1......	1	7	0	2⅔	100	100	100	.046	.060	.044	28.949	28.847	28.991	28.929
F 2......	6	12	10	9⅓	100	100	100	.057	.075	.068	28.973	29.004	29.065	29.014
S 3......	13	27	25	21⅔	100	100	100	.078	.147	·135	29.112	29.073	29.023	29.069
S 4......	23	25	13	20⅓	100	100	100	.123	.135	.078	28.826	28.812	29.056	28.898
M 5......	—6	27	23	14⅔	100	100	100	.033	.147	.123	29.214	29.107	28.993	29.105
T 6......	23	32	24	26⅓	100	100	100	.123	.181	.129	29.023	29.042	29.080	29.048
W 7......	36	41	44	40⅓	100	100	100	.212	.257	.289	28.993	28.875	28.793	28.854
T 8......	54	46	27	42⅓	100	92	100	.418	.298	.147	28.449	28.608	28.693	28.583
F 9......	14	18	12	14⅔	100	100	100	.082	.098	.075	29.380	29.479	29.526	29.462
S 10......	16	34	25	25	100	80	100	.090	.170	.135	29.443	29.282	29.196	29.307
S 11......	32	45	35	37⅓	89	71	72	.168	.247	.165	29.092	28.982	28.962	29.012
M 12......	36	42	37	38⅓	90	92	100	.199	.254	.221	28 927	28.857	28.756	28.847
T 13......	25	19	13	19	100	100	100	.135	.103	.078	28.778	28.965	29.295	29.013
W 14......	8	19	15	14	100	85	100	.062	.091	.086	29.403	29.331	29.214	29.316
T 15......	8	15	1	8	100	100	100	.062	.086	.046	29.147	29.148	29.171	29.155
F 16.	—6	9	—5	—⅔	100	100	100	.033	.065	.035	29.139	29.105	29.162	29.135
S 17......	—7	14	12	6⅓	100	100	100	.032	.082	.075	29.213	29.214	29.179	29.202
S 18......	8	18	15	13⅔	100	100	100	.062	.098	.086	29.121	29.077	29.165	29.121
M 19......	9	20	12	13⅔	100	100	100	.065	.108	.075	29.287	29.300	29.329	29.305
T 20......	15	33	29	25⅔	100	89	100	.086	.175	.160	29.268	29.144	29.106	29.173
W 21......	30	32	29	30⅓	100	100	100	.167	.181	.160	28.984	28.821	28.772	28.892
T 22......	28	28	28	28	100	100	100	.153	.153	.153	28.648	28.610	28.680	28.646
F 23......	24	38	33	31⅔	100	82	89	.129	.203	.175	28.801	28.757	28.667	28.742
S 24......	21	10	—1	10	100	100	100	.113	.068	.042	28.459	28.573	28.632	28.555
S 25......	4	12	5	7	100	100	100	.052	.075	.055	28.627	28.781	28.971	28.793
M 26......	—4	7	—7	—1⅓	100	100	100	.036	.060	.032	29.228	29.335	29.459	29.341
T 27......	0	20	15	11⅔	100	100	100	.044	.108	.086	29.564	29.527	29.422	29 504
W 28......	14	18	20	17⅓	100	100	100	.082	.098	.108	29.264	29.187	29.116	29.189
Sums	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	18.83	99.2	95.5	98.6	.105	.136	.109	....	....	....	29.047
Average..	......	......	......	......		97.8			.117		....	....	....	....

FEBRUARY, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICH.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
50	Cir.	60	Cir.	....	....	w	5	w	11	w	4	10	—4	*	4 p.m.	.03	.30
100	St.	90	St.	....	....	s w	4	w	12	w	6	14	5	Snow	flurries	.02	.20
90	Cir.	100	St.	100	Cir.St.	s w	6	s w	7	s e	3	27	13	....	....	......	......
100	St.	100	St.	10	Cir.	n e	8	n	10	n	1	27	—10	*	2 p.m.	.50	5.00
20	Cir.	90	Cir.	100	St.	s	....	s	8	s e	7	31	—6	....	....	......	......
70	Cir.	40	Cir. Cu.	40	Cir.	s w	3	w	5	s	4	37	20	In	night.	.02	.20
100	Nim.	100	Nim.	100	Nim.	s	13	s	....	s	10	54	36	7 a. m.	*	.50	......
100	St.	100	St.	100	St.	s	15	w	13	w	12	62	14	7 a. m.	5 p. m.	.04	......
10	Cir. Cu.	20	Cir. Cu.	10	Cir.	w	12	w	9	w	2	20	9	In	night.	.02	.20
15	Cir.	....	....	....	....	s	3	s w	10	s w	6	36	16	....	....	......	......
100	Cir.St.	....	....	...	....	s	9	s	11	s	10	46	32	....	....	......	......
90	Cir.St.	100	St.	100	Nim.	s	4	s	7	s	...	43	25	7 p. m.	†	......	......
100	St.	20	Cu.	....	....	w	14	w	13	w	....	25	8	....	10 a. m.	.41	.50
10	Cir.	100	St.	100	St.	w	....	w	....	w	2	20	8	6 p. m.	*	.30	3.00
30	Al.Cu.	50	Cir.St.	....	....	w	5	w	....	w	4	11	—6	Snow.	....	.02	.20
....	....	90	Cir.St.	....	....	s w	....	n	4	n w	....	10	—14	....	....	......	......
10	Cir.	....	....	50	Cir.St.	w	....	w	....	w	3	15	—7	In	night.	.01	.10
30	Cir.	10	Cir.	60	Cir.	w	....	w	5	w	4	19	6	... .	....	......	......
50	Cir.	10	Cir.	....	....	w	3	w	4	s w	2	22	5	....	....	......	......
40	Cir.	70	Cir.	90	Cir.St.	s e	9	s e	12	s e	....	33	12	....	....	......	......
100	St.	100	St.	100	St.	n e	....	n e	8	n e	7	33	26	‡	10 p. m.	.20	2.00
100	St.	100	St.	100	St.	n e	8	n w	9	n w	8	30	20	Snow.	....	.02	.20
100	St.	100	St.	100	St.	w	6	s w	8	s w	8	39	20	8 p. m.	*	.02	.20
100	St.	60	St.	....	....	n w	11	w	17	w	14	21	—2	Snow	flurries	.03	.30
100	St.	30	Cir.	....	....	w	4	w	12	w	6	14	—6	Snow	flurries	......	......
...	....	....	....	....	....	n w	3	n w	5	s	....	7	—10	....	....	......	......
70	Cir. Cu.	80	Cir.	100	St.	s	3	s w	7	s e	7	21	0	....	....	......	......
100	St.	100	St.	100	St.	n e	4	n e	9	n e	10	22	14	*	9 p. m.	1.30	13.00
....	....	....	....	....	....	...	....	...	....	....	....	......	......	....	....	3.44	25.4
63.6	....	61.4	....	48.6	....	....	....	....	....	....	....	26.8	8	....	....	......	......
57.9						....	....	....	....	....	....	......	......	....	....	.. ...	......

* In night. † Changed to snow. ‡ Snow sleet in night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
T 1......	22	28	5	18⅓	100	88	100	.118	.135	.055	29.042	28.956	28.994	28.997
F 2......	—4	32	19	15⅔	100	100	100	.036	.181	.103	28.983	29.047	29.178	29.069
S 3......	5	35	23	21	100	90	100	.055	.183	.123	29.316	29.394	29.356	29 355
S 4......	27	23	12	20⅔	100	100	100	.147	.123	.075	29.258	29.246	29 410	29.305
M 5......	8	14	13	11⅔	100	100	100	.062	.082	.078	29.420	29.356	29.099	29.292
T 6......	43	27	21	30⅓	100	100	100	.278	.147	.113	28.491	28.804	29.157	28.817
W 7......	21	30	13	21⅓	100	89	100	113	.148	.078	29.468	29.497	29.546	29.504
T 8......	3	40	25	22⅔	100	73	100	.050	.182	.135	29.552	29.414	29.325	29.430
F 9......	28	45	34	35⅔	100	84	100	.153	.251	.196	29.183	29.053	29.103	29.113
S 10......	24	33	27	28	100	89	100	.129	.168	.147	29.169	29.120	29.120	29.136
S 11......	20	22	12	18	100	100	100	.108	.118	.075	29.105	29.110	29.358	29.191
M 12......	4	26	24	18	100	100	100	.052	.141	.129	29.503	29.195	28.949	29.216
T 13......	37	32	23	30⅔	90	89	100	.199	.162	.123	28.827	29.011	29.214	29.017
W 14......	15	21	13	16⅓	100	100	100	.086	.113	.078	29.324	29.251	29.221	29.265
T 15......	16	22	6	14⅔	100	100	100	.090	.118	.057	29.068	28.985	28.978	29.010
F 16......	2	17	1	6⅔	100	100	100	.048	.094	.046	28.884	28.806	28.948	28.879
S 17......	4	14	12	10	100	100	100	.052	.082	.075	29.041	29.084	29.005	29.043
S 18......	23	39	37	33	100	91	90	.123	.216	.199	28.885	28.725	28.639	28.750
M 19......	37	41	25	34⅓	100	91	100	.221	.235	.135	28.543	28.350	28.607	28.500
T 20......	19	25	21	21⅔	100	100	100	.103	.135	.113	28.848	29.035	29.184	29.022
W 21......	20	29	23	24	100	88	100	.108	.142	.123	29.380	29.282	29.184	29.282
T 22......	32	44	40	38⅔	100	84	82	.181	.241	.203	28.952	28.891	28.921	28 921
F 23......	32	37	24	31	89	71	100	.162	.157	.129	29.167	29.194	29.235	29.199
S 24......	25	33	23	27	75	80	100	.117	.150	.123	29.280	29.226	29.195	29.234
S 25......	25	34	30	29⅔	87	89	89	.114	.175	.148	29.081	28.997	28.882	28.987
M 26......	28	30	27	28⅓	100	100	100	.153	.167	.147	28.692	28.730	28.824	28.749
T 27......	30	40	28	32⅔	89	91	100	.148	.225	.153	28.947	28.973	29.149	29.023
W 28......	24	37	27	29⅓	100	71	100	.129	.157	.147	29.318	29.280	29.245	29.281
T 29......	32	37	31	33⅓	89	81	100	.162	.178	.174	29.180	29.142	29.153	29.158
F 30......	35	35	28	32⅔	80	80	100	.162	.162	.153	29.111	29.147	29.232	29.163
S 31......	33	44	32	36⅓	89	84	100	.168	.241	.181	29.319	29.297	29.288	29.301
Sums	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	24.89	96.4	90.4	98.7	.124	.161	.123	....	....	....	29.104
Average..	......	......	......	......	95.2			.136			....	....	....	....

MARCH, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICH.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
90	St.	20	Cir.	....	....	n e	9	n e	7	w	....	28	—7	....	....	......	......
....	....	....	....	...	....	w	4	s w	8	s w	4	32	0	....	....	......	......
....	....	....	....	....	....	s w	2	s w	9	s w	7	36	6	....	....	......	......
100	St.	100	St.	100	St.	s e	3	n e	9	n e	5	31	5	*	4 p. m	.40	4.00
100	St.	100	St.	100	St.	n e	2	e	....	e	....	43	8	6 a. m.	*	.35	3.50
100	St.	100	St.	100	St.	s w	....	w	21	w	11	43	20	†	Rain.	.03	Trace
100	St.	....	....	....	....	w	6	w	8	s w	....	30	—1	....	....	......	......
....	....	....	....	10	Cir.	s	5	s e	5	s	4	41	3	....	....	......	......
50	Cir.	100	St.	100	St.	s	8	s w	5	w	3	45	22	3 p. m.	6 p. m.	.05	......
60	Cir.	100	St.	100	St.	n w	4	n w	2	e	3	33	20	....	....	......	......
100	St.	100	St.	....	....	s e	6	e	....	e	....	22	—3	....	....	......	......
....	....	90	St.	90	Cir.St.	e	....	s e	....	s	....	37	5	....	....	......	......
100	St.	100	St.	100	St.	w	8	w	10	n	5	37	14	....	....	......	......
100	Cu. St.	70	Cu. St.	....	....	n e	2	s e	3	s w	1	22	9	Snow.	....	......	Trace
100	St.	20	Cu.	10	Cu.	s w	4	w	6	n w	....	25	—10	*	‡	.10	1.00
20	Cir.	100	Cir.St.	20	Cir.	n w	2	e	4	w	....	18	—4	§	8 p. m.	.09	.91
100	St.	30	Cir. Cu.	100	St.	s w	....	s w	15	s w	12	23	4	5 p. m.	....	......	......
100	St.	10	Cir.	100	St.	s	4	s	10	s	11	42	23	3 p. m.	7 a. m.	.07	.70
100	Nim.	10	Cir.	....	....	s	8	s w	11	s w	12	41	18	....	1 p. m.	.54	.30
20	Cir.	100	Cu. St.	....	....	s w	10	w	15	w	10	26	17	Snow	flurries	.05	.50
90	St.	10	Cir.	....	....	w	6	w	14	w	9	33	20	....	....	......	......
100	St.	....	....	....	....	s w	17	w	13	w	9	44	26	....	....	......	......
....	....	....	....	....	....	n	4	n w	4	n e	3	38	15	....	....	......	......
....	....	....	....	....	....	e	3	e	4	e	2	33	19	....	....	......	......
30	Cir.	50	Cir.	90	Cir.St.	e	8	e	6	e	3	35	24	....	....	......	......
100	St.	100	St.	....	....	e	2	n	5	n	6	32	21	*	4 p. m.	.20	2.00
....	....	40	Cu.	....	....	w	6	n w	6	n	6	41	18	....	....	......	......
20	Cir.	60	Cir.	20	Cir.	n	3	n	3	n	....	37	24	....	....	......	......
40	Cir.	100	St.	30	Cir.St.	e	6	e	5	e	5	39	29	....	....	......	......
40	Cir.	100	St.	....	....	e	7	n e	7	n e	1	38	21	Sn	ow.	Trace	Trace
....	....	....	....	....	....	n w	4	n w	9	w	4	45	28	....	....	......	......
....	... .	....	....	....	....	....	....	....	....	....	....	......	......	....	....	1.88	12.90
56.8	....	51.9	....	34.5	....	...	....	....	....	....	....	34.5	12.7	....	....	......	......
		47.7				....	....	....	....	....	....	......	......	....	....	......	......

*In night. † In night, 2 p. m. ‡ 7:30 a. m. § 2:30 p. m.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
S 1......	38	49	40	42⅓	91	78	100	.221	.272	.248	29.197	29.078	29.022	29.099
M 2......	36	46	34	38⅔	100	84	100	.212	.262	.196	28.865	28.917	29.031	28.938
T 3......	36	43	29	36	80	83	100	.170	.231	.160	29.070	29.058	29.221	29.116
W 4......	29	41	35	35	77	65	80	.123	.169	.162	29.483	29.516	29.408	29.469
T 5......	37	47	42	42	81	77	83	.178	.249	.222	29.490	29.393	29.328	29.404
F 6......	49	68	56	57⅔	78	65	81	.272	.443	.363	29.207	29.044	28.945	29.065
S 7......	51	69	52	57⅓	86	70	93	.321	.496	.361	28.881	28.890	28.938	28.903
S 8......	43	48	33	41⅓	75	70	80	.209	.236	.150	29.105	29.137	29.191	29.144
M 9......	32	35	31	32⅔	69	80	78	.125	.162	.136	29.293	29.315	29.322	29.310
T 10......	29	38	29	32	88	70	88	.142	.165	.142	29.446	29.360	29.409	29.405
W 11......	28	38	33	33	88	91	100	.135	.208	.188	29.304	29.129	28.966	29.133
T 12......	33	34	30	32⅓	89	89	100	.168	.175	.167	28.952	28.977	29.013	28.981
F 13......	33	39	34	35⅓	89	100	100	.168	.238	.196	28.907	28.884	28.957	28.916
S 14......	37	55	37	43	90	74	100	.191	.308	.221	29.092	29.144	29.207	29.148
S 15......	49	59	48	52	78	82	92	.272	.410	.310	29.283	29.294	29.348	29.308
M 16......	46	58	48	50⅔	84	100	100	.262	.483	.335	29.314	29.226	29.185	29.242
T 17......	55	57	54	55⅓	94	100	100	.405	.466	.418	29.018	28.756	28.740	28.838
W 18......	54	55	46	51⅔	93	100	84	.390	.433	.262	28.770	28.779	28.887	28.812
T 19......	49	66	44	53	78	63	100	.272	.407	.289	29.075	29.089	29.191	29.118
F 20......	50	70	55	58⅓	85	61	81	.309	.449	.349	29.224	29.173	29.132	29.176
S 21......	53	58	52	54⅓	80	82	100	.321	.394	.388	29.015	28.971	28.921	28.969
S 22......	52	60	49	53⅔	100	94	100	.388	.487	.348	28.927	28.911	28.949	28.929
M 23......	49	66	56	57	100	78	94	.348	.502	.420	29.092	29.085	29.131	29.103
T 24......	53	67	45	55	86	69	92	.348	.457	.275	29.189	29.197	29.236	29.207
W 25......	50	68	46	54⅔	71	65	84	.258	.443	.262	29.284	29.232	29.269	29.262
T 26......	51	70	48	58⅓	79	57	92	.296	.416	.310	29.264	29.193	29.169	29.209
F 27......	55	74	51	60	74	59	86	.321	.497	.321	29.221	29.163	29.186	29.190
S 28......	60	76	55	63⅔	76	60	94	.396	.541	.405	29.269	29.180	29.176	29.208
S 29......	59	78	57	64⅔	82	65	100	.410	.626	.466	29.168	29.117	29.019	29.101
M 30......	48	61	47	52	78	71	92	.260	.383	.298	29.018	28.994	28.962	28.991
Sums......	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means......	......	......	......	48.43	80.0	76.7	92.5	.263	.336	.272	....	....	....	29.123
Average......	......	......	......	......	83.1			.290			....	....	....	....

APRIL, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICH.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
10	Cir.	80	Cu.	100	Nim.	s w	12	s w	9	s w	4	52	34	6 p.m.	....	......	......
100	Nim.	60	Cu.	....	....	n w	5	n w	4	w	3	49	26	....	7 a.m.	.34	......
....	....	100	Cu.St.	30	Cir. Cu.	w	3	n	8	n e	3	50	25	12:30 pm	1:20 am	*.04	......
....	....	....	....	....	....	n	7	n	8	w	12	43	28	....	....	......	......
...	....	30	Cir.	....	....	w	6	w	22	w	8	48	36	....	....	......	......
10	Cir.	10	Cir.	100	St.	w	15	s w	13	s w	10	68	41	....	....	......	......
....	....	10	Cir.	40	Cir. Cu.	n e	5	n w	6	n w	4	69	38	....	....	......	......
40	Cir St.	60	Cir.St.	10	Cir.	n e	11	n e	17	n e	8	50	27	....	....	......	......
....	....	10	Cu.	30	Cir.	n e	13	n	12	n	11	38	23	....	....	......	......
....	....	40	Cir. Cu.	...	....	n	3	n e	10	n e	14	40	23	....	....	......	......
100	St.	100	St.	100	Nim.	n e	12	n e	18	n e	8	39	28	†2 p.m.	‡	.36	.50
100	St.	100	St.	100	St.	s w	12	s w	12	s w	6	35	29	§8 p.m.	‡	.05	40
100	St.	100	St.	100	St.	s	7	s	5	w	5	39	30	8 a.m.	‡	.06	......
....	....	10	Cu.	10	Cir.	w	6	w	9	w	2	59	35	....	....	......	......
90	Cir.St.	100	St.	70	Clr.	s w	7	s	4	s	2	62	39	....	....	......	......
100	St.	100	Nim.	100	Nim.	s e	6	s e	8	s e	15	62	45	2 p.m.	‡	.07	......
100	St.	100	Nim.	100	Cu.	s e	12	s e	11	s e	7	63	50	11 a.m.	6 p.m.	.39	......
100	St.	100	St.	100	Cu. St.	s	14	s w	18	s w	14	57	34	4 p.m.	7 p.m.	.02	......
....	....	....	....	....	....	s w	10	w	8	w	0	67	34	....	....	......	......
10	Cir.	20	Cir.	100	Cir.St.	e	2	s e	11	s e	4	71	49	In	night.	.05	......
100	Cu.St.	100	St.	100	Nim.	e	7	e	7	e	3	59	49	10 a.m.	‡	.18	......
100	Nim.	100	St	....	....	s	4	s	3	s w	1	64	45	6 a.m.	7 p.m.	.44	......
100	St.	10	Cir. Cu.	10	Cir.	e	1	e	2	n e	4	66	42	....	....	......	......
....	....	....	....	....	....	n e	2	n e	6	n e	3	68	36	....	....	......	......
....	....	....	....	....	....	e	3	e	5	e	3	69	36	....	....	......	......
....	....	....	....	....	....	e	2	e	....	e	....	70	35	....	....	......	......
....	....	....	....	....	....	e	2	n	5	n w	1	74	49	....	....	......	......
....	....	....	....	....	....	n w	2	n w	....	w	....	76	44	....	....	......	......
....	....	....	....	....	....	w	3	w	5	w	3	78	46	....	....	......	......
10	Cir.	....	....	....	....	n w	11	w	10	w	5	63	37	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	.....	.....	....	....	2.00	.90
39.0	....	44.7	....	40.0	....	...	....	....	....	....	....	58.3	36.4	....	....	......	......
41.2																	

*W. frost. †Snow; thunder. ‡In night. §Snow.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
T 1......	49	66	52	55⅔	78	73	73	.272	.470	.282	29.055	28.976	28.902	28.978
W 2.....	63	69	42	58	83	75	83	.478	.529	.222	28.760	28.700	28.855	28.772
T 3......	35	48	34	39	90	70	89	.183	.236	.175	28.999	28.990	28.997	28.999
F 4......	35	44	30	36⅓	90	76	100	.183	.218	.167	28.940	28.944	29.037	28.974
S 5......	41	57	40	46	74	69	100	.190	.322	.248	29.093	29.107	29.098	29.099
S 6......	49	67	45	53⅔	71	64	84	.247	.425	.251	29.076	29.056	29.206	29.113
M 7......	51	74	60	61⅔	72	67	83	.270	.545	.442	29.151	29.032	28.972	29.052
T 8......	62	62	51	58⅓	100	100	100	.556	.556	.374	28.792	28.738	28.932	28.821
W 9......	41	55	38	44⅔	82	68	100	.212	.295	.229	29.196	29.236	29.280	29.242
T 10......	45	60	53	52⅔	84	76	100	.251	.396	.403	29.269	29.190	29.161	29.207
F 11......	54	66	61	60⅓	100	78	94	.418	.502	.505	29.044	29.001	29.032	29.026
S 12......	55	77	64	65⅓	100	82	100	.433	.758	.596	29.012	28.957	28.969	28.979
S 13......	70	83	62	71⅔	85	75	100	.621	.846	.556	29.042	29.033	29.012	29.029
M 14......	70	83	67	73⅓	85	72	100	.621	.802	.662	29.034	29.010	28.996	29.013
T 15......	72	84	59	71⅔	86	75	100	.668	.877	.500	29.018	29.011	29.090	29.040
W 16......	57	83	63	67⅔	94	87	100	.436	.983	.576	29.094	28.989	29.006	29.030
T 17......	60	60	50	56⅔	88	100	100	.456	.518	.361	29.001	28.995	29.017	29.004
F 18......	49	54	49	50⅔	100	93	92	.348	.390	.322	28.975	28.949	28.937	28.954
S 19......	55	62	45	54	87	66	100	.376	.370	.300	28.915	28.911	28.965	28.930
S 20......	51	68	50	56⅓	86	65	93	.321	.443	.335	29.023	29.009	29.005	29.012
M 21......	50	68	54	57⅓	85	69	93	.309	.476	.390	29.146	29.119	29.162	29.142
T 22......	53	75	53	60⅓	80	68	100	.321	.591	.403	29.180	29.112	29.109	29.134
W 23......	59	78	62	66⅓	88	65	94	.439	.626	.523	29.072	29.002	29.017	29.030
T 24......	64	75	63	67⅓	83	73	94	.497	.628	.543	29.007	28.975	29.027	29.003
F 25......	66	80	63	69⅔	89	70	88	.570	.717	.510	29.149	29.126	29.190	29.155
S 26......	69	79	64	70⅔	79	74	94	.564	.731	.563	29.224	29.158	29.154	29.179
S 27.....	68	70	61	66⅓	79	95	94	.543	.695	.505	29.088	29.037	29.014	29.046
M 28......	61	74	62	65⅔	94	81	100	.505	.680	.556	29.067	29.065	29.118	29.083
T 29......	62	70	64	65⅓	94	90	100	.523	.658	.596	29.154	29.142	29.144	29.147
W 30......	68	78	64	70	90	78	100	.612	.744	.596	29.134	29.108	29.113	29.118
T 31......	70	74	59	67⅔	95	90	100	.695	.758	.500	29.116	29.080	29.104	29.100
Sums.....	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	60.01	86.4	77.0	91.9	.423	.574	.426	....	....	....	29.045
Average..	......	......	......	......		85.1			.474		....	....	....	....

MAY, 1901, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow. inches.
....	....	....	....	....	....	e	4	s e	6	s	9	67	48	....	....	......	......
20	Cir.	90	Cir. Cu.	70	Cir.St.	s w	9	w	13	n w	6	73	30	4:30 pm	8 p. m.	.12	......
10	Cir.	90	Cu. St.	....	....	n w	6	n w	10	n w	0	51	31	....	....	......	......
100	St.	50	Cu. St.	....	....	n w	2	n w	6	w	0	50	26	*12 m.	†7 a. m.	.13	......
....	....	....	....	....	....	w	3	w	8	w	1	58	33	....	....	......	......
10	Cir.	30	Cir.	....	....	w	5	n	4	n e	4	68	36	....	....	......	......
10	Cir.	30	Cir.	100	Cu. St.	s e	7	s e	15	s	8	74	50	‡	4:20 pm	.10	......
100	Nim.	100	Nim.	100	St.	s	10	s w	7	n	5	64	40	....	7:30 pm	1.35	......
50	Cu.	....	....	....	....	n	6	n	7	n w	1	56	30	....	....	......	......
80	Cu. St.	60	Cir.	100	St.	w	4	w	13	w	1	63	45	....	....	......	......
100	St.	90	St.	80	Cir.St.	s w	6	s w	6	s e	2	70	53	Show	ers	.11	......
90	Nim.	100	St.	10	Cir.	s e	3	s w	6	s w	....	79	54	Show	ers	.15	......
....	....	....	....	....	....	w	....	w	10	w	....	84	61	....	....	......	......
20	Cir.	80	Cu. St.	20	Cir.	s w	....	s w	14	s w	3	80	62	....	....	......	......
....	....	50	Cu.	90	Cu. St.	s w	5	s w	7	n	4	85	49	....	....	......	......
100	St.	50	Cu.	100	Cu. St.	n	5	s e	9	s e	3	84	54	9:30 pm	*	.02	......
60	Cir.	100	Nim.	30	Cir.	s e	2	n w	5	n w	2	65	47	10:30 am	3 p. m.	.02	......
100	Nim.	100	St.	100	St.	n e	4	n e	....	n e	....	57	43	7 a. m.	10 a. m.	.06	......
10	Cir.	10	Cir.	....	....	n e	....	n	7	n	1	65	35	....	....	......	......
....	....	30	Cu.	....	....	n	2	n w	8	n w	2	69	36	....	....	......	......
....	....	....	....	....	....	n w	3	n w	5	w	2	71	36	....	....	......	......
....	....	10	Cir.	....	....	s w	2	s w	5	s w	0	75	46	....	....	......	......
90	St.	30	Cir.	90	St.	e	1	s e	3	s e	0	73	53	....	....	......	......
100	St.	90	St.	60	St.	e	1	n e	3	n e	1	76	54	....	....	......	......
60	Cir.St.	20	Cu.	....	....	n e	0	n e	2	n e	1	81	53	....	....	......	......
....	....	30	Cir.St.	....	....	s	3	s	5	s	1	81	58	....	....	......	......
80	Cu. St.	30	Cu.	....	....	s	5	w	6	n w	1	72	57	10 a. m.	5 p. m.	.65	......
70	Cir. Cu.	60	Cu.	90	St.	n	2	s e	7	s e	5	73	57	*	7 p. m.	1.30	......
100	St.	80	Cu. St.	....	....	s e	5	s e	7	s e	4	73	60	....	....	......	......
100	Cu. St.	30	Cu.	20	Cir.	s w	4	w	7	s w	0	79	61	....	....	......	......
100	St.	100	St.	30	Cir.	s w	5	s w	2	s w	0	74	57	2:40 pm	4 p. m.	.16	......
....	....	....	....	....	....	....	....	....	....	....	....	......	......	....	....	4.17	......
50.3	....	49.7	....	35.2	....	....	....	....	....	....	....	70.6	46.9	....	....	......	......
		45.1				....	....	....	....	....	....	......	......	....	....	......	......

* In night. † Snow and rain. ‡ 3:30 p. m., 9 p. m.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
F 1......	66	67	65	66	94	100	100	.604	.662	.618	29.081	28.976	28.914	28.990
S 2......	61	61	51	57⅔	94	88	100	.505	.473	.374	28.939	29.041	29.155	29.045
S 3......	56	70	57	61	81	80	100	.363	.586	.466	29.540	29.198	29.222	29.320
M 4......	62	72	59	64⅓	88	81	100	.491	.631	.500	29.275	29.214	29.199	29.339
T 5......	67	80	62	69⅔	84	70	100	.556	.717	.556	29.239	29.148	29.187	29.191
W 6......	66	78	70	71⅓	89	95	95	.570	.914	.695	29.001	28.860	28.798	28.886
T 7......	71	80	64	71⅔	95	96	100	.720	.977	.596	28.786	28.800	28.821	28.802
F 8......	63	73	55	63⅔	83	72	94	.478	.581	.405	28.861	28.898	29.034	28.931
S 9......	66	71	59	65⅓	84	76	100	.536	.572	.500	29.190	29.164	29.137	29.164
S 10......	70	82	66	72⅔	75	83	100	.551	.904	.639	29.009	28.877	28.957	28.948
M 11......	62	73	58	64⅓	88	72	100	.491	.581	.483	29.109	29.183	29.247	29.180
T 12......	59	70	56	61⅔	82	70	100	.410	.516	.449	29.299	29.194	29.174	29.222
W 13......	64	66	61	63⅔	83	100	100	.497	.639	.537	29.079	28.975	28.997	29.017
T 14......	67	75	56	66	84	81	100	.556	.705	.449	29.169	29.170	29.229	29.189
F 15......	64	75	58	65⅔	77	73	100	.464	.628	.483	29.337	29.284	29.234	29.285
S 16......	64	78	62	68	77	73	100	.464	.704	.556	29.187	29.102	29.084	29.124
S 17......	66	78	62	68⅔	84	69	83	.536	.664	.460	29.097	29.087	29.154	29.113
M 18......	64	73	55	64	83	77	100	.497	.617	.433	29.222	29.213	29.279	29.238
T 19......	63	77	58	62⅔	83	65	100	.478	.601	.483	29.322	29.286	29.297	29.302
W 20......	71	79	60	70	80	74	100	.608	.731	.518	29.259	29.164	29.088	29.170
T 21......	70	79	63	70⅔	80	82	100	.586	.813	.576	28.967	28.830	28.781	28.859
F 22......	63	69	66	66	100	100	94	.576	.708	.604	28.731	28.820	28.961	28.837
S 23......	67	80	63	70	89	74	100	.591	.758	.576	29.161	29.042	28.956	29.053
S 24......	69	86	70	73	85	68	100	.599	.850	.733	29.031	29.007	28.973	29.004
M 25......	76	89	72	79	81	69	100	.731	.948	.785	29.013	28.965	28.975	28.984
T 26......	79	88	71	79⅓	87	73	100	.856	.962	.759	28.915	28.822	28.792	28.843
W 27......	73	85	70	76	90	79	100	.732	.955	.733	28.735	28.727	28.792	28.751
T 28......	73	82	60	71⅔	85	79	100	.693	.859	.518	28.827	28.856	28.897	28.860
F 29......	65	71	54	63⅓	84	71	87	.516	.537	.362	28.923	28.950	29.088	28.987
S 30......	56	67	57	60	81	75	87	.363	.489	.407	29.208	29.171	29.191	29.190
Sums......	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means......	......	......	......	67.59	88.3	79.2	98.0	.554	.710	.545	....	....	....	29.064
Average..	......	......	......	......	88.5			.603			....	....	....	....

JUNE, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	Nim.	30	Cir.	s w	5	s w	3	s w	1	70	59	*	8 p. m.	.45	......
60	Cir. Cu.	80	Cu. St.	90	St.	w	7	n w	9	n w	1	64	44	....	....	......	......
....	....	10	Cir.	....	....	n e	0	n e	0	e	1	71	46	....	....	......	......
....	....	20	Cir. Cu.	....	....	s e	2	s e	3	s	0	76	49	....	....	......	......
....	....	....	....	....	....	s	2	s	6	s	4	80	54	....	....	......	......
100	St.	100	Nim.	60	Cu. St.	s	3	s w	9	s w	5	80	66	12 noon.	4 p. m.	.03	......
80	St.	100	Nim.	30	Cir.	s w	7	s w	7	s w	1	83	58	†	‡	.77	......
80	Cu. St.	....	....	....	....	s w	2	w	10	n w	2	74	41	5 a. m.	§	.02	......
....	....	10	Cir.	20	Cir.	n e	2	s e	4	s e	2	73	53	....	....	......	......
20	Cir.	80	Cir.	40	Cir. Cu.	s e	0	s w	15	w	4	83	55	5 p. m.	7 p. m.	.35	......
...	....	10	Cir.	40	Cir.	n	8	n w	5	n w	2	74	48	....	....	......	......
40	Cir.	10	Cir.	20	Cir.	e	10	e	5	e	4	71	45	....	....	......	......
30	Cir.	80	Cu. St.	100	St.	e	5	n	4	n	12	77	55	‖	9 p. m.	.54	......
50	Cir.	40	Cu.	20	Cir.	n	4	n	7	n w	1	76	48	....	....	......	......
40	Cir.	....	....	....	....	n e	9	e	9	e	7	75	48	....	....	......	......
40	Al. Cu.	....	....	....	....	e	6	e	11	e	4	78	50	....	....	......	......
10	Cir.	....	....	....	....	e	4	e	6	e	11	78	47	....	....	......	......
....	....	....	....	....	....	e	6	n	9	n	6	73	45	....	....	......	......
....	....	10	Cu.	....	....	n	3	n	6	n	4	78	48	....	....	......	......
....	....	....	....	....	....	w	6	w	6	s w	4	81	50	....	Solar halo.		......
10	Cir.	40	Cir. Cu.	100	Nim.	s	9	s e	11	s e	5	81	51	¶	....	......	......
100	Nim.	100	Nim.	100	St.	s e	11	s e	11	e	6	74	58	....	4 p. m.	.34	......
....	....	30	Cu.	....	....	n e	6	n e	12	e	3	81	52	....	....	......	......
10	Cir.	....	....	....	....	s e	1	s e	2	s e	1	87	61	....	....	......	......
....	....	....	....	....	....	s e	3	s e	5	s	1	89	66	....	....	......	......
....	....	20	Cu.	....	....	s w	6	s w	9	s w	4	88	68	....	....	......	......
20	Cir.	70	Cu. St.	....	....	s w	9	w	9	w	2	87	63	**	6 p. m.	.07	......
....	....	....	....	....	....	w	7	s w	11	w	0	82	55	....	....	......	......
10	Cir.	....	....	....	....	w	8	w	12	n w	4	72	49	....	....	......	......
....	....	....	....	....	....	n w	....	n w	8	n w	2	71	50	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	......	......	....	....	2.57	....
26.7	....	30.3	....	21.7	....	....	....	....	....	....	....	77.6	52.7	....	....	......	......
26.2						....	....	....	....	....	....	......	......	....	....	......	......

* 9:30 a. m. † 1:45 p. m. ‡ 2:30 p. m. § 6:30 a. m. ‖ 11:30 a. m. ¶ 5:30 p. m. ** In night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
S 1......	58	76	64	66	82	68	83	.394	.614	.497	29.277	29.227	29.221	29.242
M 2......	66	69	76	70⅓	84	100	91	.536	.708	.812	29.211	29.106	29.036	29.118
T 3......	75	79	78	77⅓	90	87	95	.785	.856	.914	29.020	29.018	29.025	29.021
W 4......	77	91	73	80⅓	95	77	100	.884	1.121	.812	29.115	29.074	29.072	29.087
T 5......	83	92	78	84⅓	87	74	91	.983	1.108	.870	29.089	29.024	28.976	29.030
F 6......	80	91	71	80⅔	87	74	90	.886	1.070	.682	28.956	28.884	28.971	28.937
S 7......	69	76	68	71	100	91	100	.708	.812	.685	28.887	28.784	28.750	28.807
S 8......	62	66	57	61⅔	94	84	100	.523	.536	.466	28.746	28.810	28.894	28.817
M 9......	58	70	54	60⅔	82	70	100	.394	.516	.418	28.934	28.928	29.021	28.961
T 10......	65	69	70	68	78	85	90	.483	.599	.658	29.048	28.934	28.901	28.961
W 11......	71	74	55	66⅔	90	81	100	.682	.680	.433	28.923	29.004	29.104	29.010
T 12......	63	72	56	63⅔	83	76	100	.478	.595	.449	29.142	29.147	29.174	29.154
F 13......	66	75	60	67	84	77	100	.536	.666	.518	29.197	29.168	29.158	29.174
S 14......	69	86	70	75	85	80	100	.599	.989	.733	29.131	29.042	29.070	29.081
S 15......	80	89	78	82⅓	87	84	91	.886	1.188	.870	29.043	28.981	28.957	28.994
M 16......	77	78	73	76	91	100	100	.841	.958	.812	28.962	28.926	28.925	28.938
T 17......	75	71	66	70⅔	90	100	94	.785	.759	.604	28.915	28.949	29.026	28.997
W 18......	64	75	64	67⅔	89	81	100	.529	.705	.596	29.181	29.121	29.146	29.156
T 19......	69	82	69	73⅓	95	83	100	.671	.904	.708	29.138	29.036	29.040	29.071
F 20......	71	80	64	71⅔	86	87	100	.644	.886	.596	29.016	28.906	29.006	28.976
S 21......	61	77	61	66⅓	94	77	100	.505	.717	.537	29.264	29.223	29.247	29.245
S 22......	69	82	65	72	85	79	100	.599	.859	.618	29.263	29.248	29.216	29.242
M 23......	74	82	71	75⅔	90	87	100	.758	.950	.759	29.194	29.148	29.150	29.164
T 24......	64	69	67	66⅔	100	100	100	.596	.708	.662	29.078	29.020	28.956	29.018
W 25......	65	78	65	69⅓	89	69	89	.549	.664	.549	28.961	28.972	29.036	28.990
T 26......	58	69	55	60⅔	76	65	100	.365	.462	.433	29.162	29.153	29.194	29.170
F 27......	59	75	58	64	88	64	100	.439	.554	.483	29.265	29.220	29.228	29.238
S 28......	60	81	63	68	88	62	100	.456	.664	.576	29.235	29.123	29.108	29.155
S 29......	72	82	68	74	86	87	90	.668	.950	.612	29.028	28.977	29.006	29.004
M 30......	66	78	61	68⅓	84	62	100	.536	.588	.537	29.111	29.142	29.118	29.124
T 31......	72	84	64	73⅓	76	60	89	.595	.704	.529	29.091	29.085	29.168	29.115
Sums	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Means....	......	......	......	70.73	87.6	79.1	96.5	.622	.777	.626	....	....	....	29.064
Average .	......	......	......	......	87.7			.675			....	....	....	....

JULY, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
		10	Cir.	10	Cir.	s e	3	e	2	e	4	79	58				
100	St.	100	Nim.	100	St.	s e	11	s	8	s	10	81	65	*	3 p. m.	.23	
50	Cir.St.	40	Cir.St.			s	12	s w	8	s w	4	88	67	In	night.	.11	
40	Cu. St.	30	Cir. Cu.			s w	2	s w	11	s w	0	92	71				
		20	Cu.			s w	6	w	12	w	6	93	74				
40	Cu.			90	Cu.	s w	10	w	13	w	12	91	65	9 p. m.			
100	Cu.St.	100	St.	100	St.	s e	8	s e	4	w	6	77	62		6 p. m.	.71	
100	St.	100	St.	100	Nim.	n w	10	n w	12	n	4	68	53	5 p. m.	†	.09	
90	Cu.St.	10	Cu.	10	Cir.	n w	7	w	10	w	1	72	46				
80	St.	60	Cir.St.	30	Cir.	s	4	s	8	s	8	79	60	9 a. m.	12 noon	.06	
90	Cir.St.	30	Cu.			s w	8	n w	11	n w	4	78	47	In	night.	.10	
		30	Cu.			n		n	6	n	0	74	49				
		30	Cir.			n	1	n	2	n w	1	80	55				
90	St.	10	Cir.	90	Cu.	s w	7	s w	9	s w	8	84	67	7 p. m.	†	.17	
		40	Cu.	20	Cu.	s	6	s w	12	w	6	90	70				
100	St.	100	Nim.	100	Nim.	s w	8	w	12	w	8	80	68	8 a. m.	3 p. m.	.19	
90	St.	100	St.	100	St.	w	10	w	10	w	3	75	56	†	2 p. m.	.81	
60	Cir. Cu.	10	Cu.			n e		n e	2	e	0	79	61				
100	St.	60	Cu.			s e	0	s e		s		84	58				
		40	Cu.St.	100	St.	s		s		s w		84	52	11 a. m.	3 p. m.	.10	
						n		n e	3	n e	1	79	51				
						s e	2	s	4	s	0	83	59				
		60	Cu.St.			s w	4	s w	4	s w	1	86	64				
100	Nim.	100	Nim.	100	Nim.	n w	5	n e	1	e	1	70	60	‡	†	1.58	
		50	Cu.	10	Cu.	n e	3	n	3	n	3	80	49				
		20	Cu.			n	5	n w	4	n w	0	73	46				
						n w		n w		s w		77	49				
		10	Cir.			s w		s w	5	s	0	83	59				
60	Cir.St.	100	Cu. St.	10	Cu.	s	4	s w	6	w	2	84	56				
						n	3	n w	4	w	1	80	55				
		20	Cu.			w	8	w	6	w	3	85	52				
																4.15	
38.4		41.3		31.3								80.9	58.2				
37.0																	

* 11:30 a. m.

† In night.

‡ 6:20 a. m.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
W 1......	59	74	58	$63\frac{2}{3}$	88	77	100	.456	.641	.483	29.237	29.205	29.187	29.210
T 2......	62	71	63	$65\frac{1}{3}$	94	90	94	.523	.682	.543	29.114	29.083	29.134	29.110
F 3......	61	81	69	$70\frac{1}{3}$	88	70	65	.473	.745	.462	29.217	29.206	29.220	29.214
S 4......	68	89	74	77	79	77	86	.543	1.046	.718	29.274	29.216	29.230	29.233
S 5......	81	94	72	$82\frac{1}{3}$	79	71	100	.829	1.133	.785	29.237	29.193	29.207	29.212
M 6......	78	91	71	80	86	77	95	.827	1.121	.771	29.227	29.207	29.172	29.202
T 7......	72	90	76	$79\frac{1}{3}$	100	73	91	.785	1.033	.812	29.258	29.202	29.198	29.219
W 8......	78	91	70	$79\frac{2}{3}$	78	77	100	.744	1.121	.733	29.222	29.206	29.228	29.219
T 9......	76	90	76	$80\frac{2}{3}$	86	80	95	.772	1.135	.884	29.198	29.146	29.093	29.146
F 10......	78	91	74	81	86	77	90	.827	1.121	.758	29.128	29.064	29.046	29.079
S 11......	75	92	75	$80\frac{2}{3}$	90	57	100	.785	.860	.868	29.042	29.134	29.019	29.065
S 12......	75	76	71	74	90	95	90	.785	.854	.682	28.972	28.934	28.973	28.960
M 13......	62	74	64	$66\frac{2}{3}$	94	86	97	.523	.718	.590	29.008	29.007	29.096	29.037
T 14	67	76	69	$70\frac{2}{3}$	89	95	100	.591	.854	.708	29.081	29.043	29.056	29.060
W 15......	68	73	66	69	90	100	100	.612	.812	.639	29.098	29.060	29.088	29.082
T 16	67	81	68	72	95	83	100	.626	.873	.685	29.155	29.120	29.165	29.147
F 17......	71	84	69	$74\frac{2}{3}$	86	75	100	.644	.877	.708	29.177	29.146	29.182	29.168
S 18......	76	86	73	$78\frac{1}{3}$	86	84	100	.772	1.038	.812	29.165	29.180	29.177	29.174
S 19......	78	92	70	80	86	70	100	.827	1.056	.733	29.190	29.124	29.100	29.138
M 20......	77	92	68	79	86	67	100	.799	1.005	.685	29.070	28.965	28.985	29.007
T 21......	69	73	66	$69\frac{1}{3}$	100	90	100	.708	.732	.639	29.020	29.034	29.090	29.048
W 22......	63	82	67	$70\frac{2}{3}$	100	75	95	.576	.816	.626	29.096	29.043	29.050	29.063
T 23......	71	81	69	$73\frac{2}{3}$	86	96	100	.644	1.010	.708	28.953	28.915	28.900	28.923
F 24......	66	85	76	$75\frac{2}{3}$	100	79	100	.639	.955	.897	28.958	28.890	28.905	28.918
S 25......	74	84	66	$74\frac{2}{3}$	86	79	100	.718	.923	.639	28.930	28.951	29.017	28.966
S 26......	75	76	68	73	86	100	100	.745	.897	.685	29.083	28.987	29.067	29.046
M 27......	68	74	67	$69\frac{2}{3}$	100	90	100	.685	.758	.662	29.083	29.093	29.113	29.096
T 28.	68	81	65	$71\frac{1}{3}$	95	83	100	.648	.873	.618	29.158	29.144	29.170	29.157
W 29......	65	78	68	$70\frac{1}{3}$	100	73	100	.618	.704	.685	29.210	29.215	29.253	29.226
T 30......	66	81	65	$70\frac{2}{3}$	89	79	100	.570	.829	.618	29.263	29.260	29.272	29.265
F 31......	67	85	65	$72\frac{1}{3}$	84	68	100	.556	.819	.618	29.323	29.280	29.300	29.301
Sums	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	74.05	89.7	80.4	96.7	.673	.905	.692	....	....	....	29.119
Average..	......	......	......	......	88.9			.757			....	....	....	....

AUGUST, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
....	....	40	Cu.	15	Nim.	w	....	s w	3	w	2	76	57	In	night.	......	......
50	Cu. St.	75	Cu.	....	....	n w	4	n w	....	s w	....	75	52	9:30 am	10 a. m.	.01	......
10	Cu.	...	....	....	....	s e	....	s	3	s w	0	82	59	....	....	......	......
10	Cu.	....	....	....	....	s w	3	w	....	s w	....	87	66	....	....	......	......
....	....	30	Cu.	....	....	s w	....	s e	....	s	7	94	66	....	....	......	......
10	St.	40	Cu.	10	Cu.	s e	....	s w	7	s w	0	90	65	....	....	......	......
...	....	40	Cu.	....	....	w	7	s e	8	s e	3	91	69	....	....	......	......
....	....	10	Cu.	....	....	s w	7	s w	8	s w	1	91	66	....	....	......	......
60	St.	60	Cu.	....	....	s w	5	w	5	s w	1	91	68	....	....	......	......
15	St.	70	Cu.	....	....	w	4	s w	8	w	2	92	69	....	....	......	......
20	St.	30	Cu.	40	Cu. St.	n w	7	w	13	w	5	93	68	7:30 pm	10:30 pm	.20	......
90	Nim.	75	Cu.	100	Nim.	s e	5	s w	6	n w	4	80	69	8:30 am	10 a. m.	.04	......
100	Nim.	80	Cu. St.	75	Cu.	s w	4	s w	5	s w	4	75	45	....	....	......	......
50	Cu.	95	Cu.	20	Cu.	s w	2	s w	2	s w	1	81	60	1 p. m.	3 p. m.	.01	......
50	Cir. St.	100	Nim.	70	St.	e	2	s e	4	s	1	81	61	1 p. m.	4 p. m.	.13	......
70	Cir. St.	20	Cu.	....	....	s w	2	s w	3	w	1	83	59	....	....	......	......
10	Cir.	100	St.	....	....	s w	3	s w	3	s w	0	85	62	....	....	......	......
....	....	90	Cu. St.	20	Cu.	s w	2	s w	2	s w	0	89	68	....	....	......	......
10	Cir.	30	Cu. St.	30	Cu.	s w	4	s w	11	s w	3	94	68	3 p. m.	5 p. m.	.21	......
10	Cir.	90	Cu. St.	80	St.	s w	5	w	11	n w	2	93	66	3 p. m.	6 p. m.	.38	......
100	Nim.	100	St.	....	....	e	3	e	3	e	1	78	58	....	....	......	......
100	St.	30	Cu.	....	....	e	1	e	7	e	3	83	60	....	....	......	......
90	St.	100	St.	....	....	s e	6	s e	2	e	0	85	62	2 p. m.	5:30 pm	.16	......
100	Nim.	40	Cu. St.	10	Cu.	e	4	e	8	s	6	86	63	7 a. m.	9 a. m.	.28	......
....	....	60	Cu.	....	....	s	6	s	8	s	1	86	62	In	night.	.96	......
10	Cir.	100	Nim.	....	....	s e	5	s	6	s w	4	85	65	1:30 pm	3 p. m.	.31	......
100	Nim.	70	St.	....	....	w	4	w	3	n w	0	78	60	*	9 a. m.	.03	......
50	Cir.	70	St.	....	....	n w	1	n w	1	n	0	83	56	5:30 pm	6:30 pm	.09	......
....	....	....	....	....	....	n	3	n e	2	e	0	79	52	....	....	......	......
....	....	....	....	....	....	e	1	e	2	e	0	83	53	....	....	......	......
....	....	....	....	....	....	s e	1	s e	5	s e	1	86	60	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	......	......	....	....	2.98	......
36.3	....	56.3	......	15.2	....	....	....	....	....	....	....	85.	61.7	....	....	......	......
		35.9				....	....	....	....	....	....	......	......	....	....	......	......

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* In night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
S 1......	74	88	73	78⅓	86	73	100	.718	.962	.812	29.286	29.227	29.231	29.248
S 2......	75	83	73	77	86	79	90	.745	.891	.732	29.220	29.209	29.077	29.169
M 3......	66	76	58	66⅔	100	73	100	.639	.652	.483	29.183	29.208	29.276	29.222
T 4......	62	81	60	67⅔	94	66	100	.523	.704	.518	29.375	29.333	29.290	29.333
W 5......	64	87	76	75⅔	89	76	91	.529	.976	.802	29.276	29.243	29.060	29.193
T 6......	77	86	72	78⅓	91	76	86	.841	.942	.668	29.020	29.014	29.127	29.054
F 7......	64	77	61	67⅓	89	77	100	.529	.717	.537	29.277	29.237	29.228	29.247
S 8......	65	79	66	70	84	82	100	.516	.818	.639	29.263	29.222	29.227	29.237
S 9......	72	78	69	73	81	78	95	.631	.744	.671	29.256	29.244	29.237	29.246
M 10......	67	89	73	76⅓	89	80	95	.591	1.097	.798	29.237	29.132	29.087	29.152
T 11......	78	87	75	80	82	69	100	.785	.882	.868	28.977	28.714	28.527	28.739
W 12......	61	71	62	64⅔	94	80	94	.505	.608	.523	29.001	29.022	29.031	29.018
T 13......	58	78	56	64	88	86	100	.423	.827	.449	29.088	29.052	29.104	29.095
F 14......	60	75	59	64⅔	88	77	94	.456	.666	.469	29.191	29.142	29.148	29.160
S 15......	66	78	69	71	84	78	90	.536	.744	.635	29.009	28.837	28.801	28.882
S 16......	54	51	47	50⅔	93	93	92	.390	.348	.298	28.902	28.995	29.016	28.971
M 17......	49	52	42	47⅔	92	96	100	.322	.361	.267	29.069	29.177	29.234	29.160
T 18......	45	68	51	56	68	79	93	.204	.543	.348	29.344	29.277	29.280	29.300
W 19......	54	61	58	57⅔	87	94	100	.362	.505	.483	29.253	29.086	28.967	29.102
T 20......	61	75	56	64	94	77	100	.505	.666	.449	29.008	28.918	28.973	28.964
F 21......	55	61	46	54	87	88	100	.376	.473	.311	29.104	29.121	29.170	29.132
S 22......	52	69	54	58⅓	86	79	100	.334	.564	.418	29.249	29.168	29.113	29.177
S 23......	55	68	50	57⅔	94	85	100	.405	.577	.361	29.039	29.039	29.143	29.074
M 24......	47	71	66	61⅓	92	80	84	.298	.608	.556	29.251	29.194	29.145	29.197
T 25......	74	90	73	79	81	70	95	.680	.983	.771	29.172	29.141	29.190	29.168
W 26......	73	80	67	73⅓	90	87	95	.736	.886	.626	29.187	29.184	29.260	29.210
T 27......	53	62	50	55	86	83	100	.348	.460	.361	29.366	29.341	29.366	29.358
F 28......	50	67	56	57⅔	93	84	100	.335	.556	.449	29.388	29.237	29.137	29.254
S 29......	60	63	49	57⅓	94	94	100	.487	.543	.348	29.031	29.076	29.207	29.105
S 30......	45	70	50	55	92	80	100	.275	.586	.361	29.271	29.240	29.271	29.261
Sums														
Means......				65.31	88.5	80.6	96.5	.500	.696	.534				29.151
Average..					88.5			.577						

SEPTEMBER, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
....	....	20	Cu.	...	....	se	3	s	7	s	5	90	68	....	....	......	......
....	....	50	Cir. Cu.	20	Cir.	s	9	se	11	se	7	84	64	11 a. m.	2 p. m.	.05	......
100	St.	....	....	....	....	w	2	w	6	w	1	77	48	*	7 a. m.	.21	......
....	....	....	....	10	Cu.	ne	1	e	3	e	0	81	56	....	....	......	......
10	Cir.	50	Cir. Cu.	....	....	s	3	s w	9	s w	7	87	65	....	....	......	......
...	....	....	....	90	Cir. Cu.	s w	7	s w	6	n w	3	87	58	In night.		.01	......
20	Cu.	....	....	....	....	ne	3	ne	3	ne	0	77	50	....	....	......	......
20	Cir.	20	Cir.	10	Cir.	e	0	e	2	e	1	81	60	....	....	......	......
80	Cu. St.	80	Cu. St.	....	....	e	1	e	2	e	0	83	60	....	....	......	......
70	Cu. St.	40	Cir. St.	20	Cir.	s	3	s	3	s w	1	90	66	....	....	......	......
70	Cir. St.	100	Cu. St.	100	St.	s w	6	s w	16	s w	17	91	59	5:30 pm	*	.08	......
20	Cir. Cu.	10	Cir.	10	Cu.	n w	7	n w	6	w	1	72	43	....	....	......	......
....	....	....	....	....	....	s w	3	s w	6	n w	1	78	49	....	....	......	......
....	....	....	....	....	....	ne	3	ne	3	ne	2	77	49	....	....	......	......
....	....	40	Cir. Cu.	....	....	se	10	se	3	s w	6	80	52	12 m.	1 p. m.	Trace	......
70	Cir. St.	100	St.	100	St.	w	10	w	11	w	7	55	41	In night.		.02	......
100	St.	100	St.	....	....	n w	9	n w	6	n w	1	53	32	....	....	......	......
10	Cir.	50	Cir.	....	....	e	0	se	2	se	2	69	45	In night.		.02	......
100	St.	100	St.	100	Nim.	se	5	se	10	se	9	63	53	12 m.	*	.16	......
80	Cir. St.	70	Cu. St.	50	Nim.	s w	5	s w	11	s w	2	77	46	8 p. m.	*	.02	......
20	Cir.	100	St.	....	....	w	5	w	6	w	1	64	39	....	....	......	......
....	....	30	Cir. Cu.	20	Cir. St.	w	1	s w	3	s w	0	70	51	In night.		.02	......
70	Cir. St.	10	Cu.	....	....	n w	2	n w	7	n w	0	73	39	....	....	......	......
40	Cir.	100	St.	100	St.	se	1	s	4	s	10	75	45	....	....	......	......
10	Cir.	20	Cu.	....	....	s	7	s	11	s	5	91	68	....	....	......	......
20	Cir. Cu.	30	Cir. Cu.	80	Cir. St.	s	6	s w	7	w	2	82	50	9 a. m.	10 a. m.	Trace	......
30	Cir.	90	St.	10	Cir.	ne	3	ne	3	ne	1	63	38	....	....	......	......
....	....	100	St.	100	Nim.	e	2	se	7	s	5	70	50	8 a. m.	*	.30	......
100	St.	100	St.	....	....	w	1	w	....	n w	....	65	38	....	....	......	......
20	Cir.	...	....	....	....	w	0	w	0	w	0	70	40	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	......	......	....	....	.87	......
35.3	....	46.7	....	27.7	....	....	....	....	....	....	....	75.8	50.7	....	....	......	......
36.6						....	....	....	....	....	....	......	......	....	....	......	......

* In night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
M 1......	46	68	52	55⅓	84	79	100	.262	.543	.388	29.370	29.318	29.318	29.335
T 2......	59	78	67	68	94	82	89	.469	.785	.591	29.315	29.252	29.265	29.277
W 3......	63	82	62	69	88	79	100	.510	.859	.556	29.349	29.303	29.270	29.307
T 4......	64	85	62	70⅓	89	68	100	.529	.819	.556	29.230	29.124	29.127	29.161
F 5......	66	85	64	71⅔	89	75	100	.570	.909	.596	29.130	29.058	29.108	29.099
S 6......	70	85	72	75⅔	90	75	100	.658	.909	.785	29.112	29.000	28.983	29.032
S 7......	63	56	52	57	100	94	93	.576	.420	.361	28.916	29.033	29.239	29.063
M 8......	48	59	47	51⅓	85	94	100	.297	.469	.323	29.355	29.340	29.389	29.361
T 9......	42	58	39	46⅓	91	82	100	.244	.394	.238	29.423	29.366	29.405	29.378
W 10......	39	64	42	48⅓	82	83	100	.195	.497	.267	29.409	29.330	29.305	29.348
T 11......	42	67	43	50⅔	91	79	100	.244	.522	.278	29.268	29.155	29.147	29.190
F 12......	46	66	45	52⅓	92	78	100	.286	.502	.300	29.153	29.110	29.128	29.130
S 13......	49	63	57	54⅓	92	88	100	.322	.510	.374	29.173	29.140	29.129	29.147
S 14......	46	71	46	54⅓	92	80	100	.286	.608	.311	29.167	29.173	29.211	29.184
M 15......	43	73	50	55⅓	83	72	100	.231	.581	.361	29.257	29.179	29.101	29.179
T 16......	47	50	31	43⅔	85	92	100	.273	.322	.174	29.224	29.386	29.460	29.357
W 17......	31	53	35	39⅔	89	80	100	.155	.321	.204	29.486	29.311	29.261	29.353
T 18......	44	63	47	51⅓	92	83	85	.265	.478	.273	29.178	29.132	29.240	29.183
F 19......	41	56	40	45⅔	91	75	91	.235	.336	.225	29.353	29.249	29.224	29.275
S 20......	42	66	51	53	83	73	86	.222	.470	.348	29.185	29.091	29.093	29.123
S 21......	50	70	63	61	93	75	83	.335	.551	.478	29.089	29.074	29.056	29.073
M 22......	60	69	64	64⅓	88	90	100	.456	.635	.596	29.027	28.962	28.920	28.970
T 23......	57	62	51	56⅔	94	88	100	.436	.491	.374	28.957	28.986	29.200	29.048
W 24......	53	65	60	59⅓	93	89	100	.375	.549	.518	29.438	29.458	29.476	29.457
T 25......	55	71	57	61	94	80	94	.405	.608	.436	29.449	29.311	29.272	29.344
F 26......	60	70	47	59	88	85	100	.456	.621	.323	29.203	29.169	29.296	29.223
S 27......	48	54	47	49⅔	92	93	100	.310	.390	.323	29.352	29.282	29.282	29.305
S 28......	47	65	57	56⅓	92	84	87	.298	.536	.407	29.191	29.130	29.063	29.128
M 29......	61	69	60	63⅓	88	90	100	.491	.635	.518	28.994	28.945	28.973	28.971
T 30......	58	62	61	60⅓	100	100	100	.483	.556	.537	29.026	29.016	29.070	29.037
W 31......	61	74	67	67⅓	100	81	84	.537	.680	.556	29.081	28.995	28.968	29.015
Sums.....	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	57.12	90.5	82.8	96.5	.336	.565	.405	....	....	....	29.195
Average..	......	......	......	......	89.9			.435			....	....	....	....

OCTOBER, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
10	Cir.	10	Cir.	....	....	0	0	s e	6	s e	1	70	46	....	....	......	......
100	St.	70	Cir. st.	30	Cir.	s e	4	s	7	s	3	80	54	....	....	......	......
60	Cir.	50	Cir.	....	....	s w	2	s w	1	s w	1	85	56	....	....	......	......
....	....	30	Cu. st.	10	Cir.	s w	2	s w	7	w	1	86	56	....	....	......	......
10	Cir.	20	Cir.	....	....	s w	1	s w	10	s w	1	87	62	....	....	......	......
40	Cir.	70	Cu.	100	Nim.	s w	4	s w	10	s	12	86	62	7 p. m.	....	......	......
100	Nim.	100	St.	100	St.	s w	5	w	8	n w	2	63	45	....	9 a. m.	1.11	......
60	Al Cu.	100	St.	....	....	n e	2	e	2	e	2	59	37	....	....	......	......
100	St.	20	Cu.	....	....	w	2	n w	4	n	0	59	32	....	....	......	......
....	....	....	....	....	....	n w	1	n w	2	n w	0	64	34	....	....	......	......
....	....	10	Cir.	10	Cir.	s w	1	s w	2	s w	0	67	38	....	....	......	......
90	Cir.St.	20	Cir.	....	....	s w	0	s w	2	s w	0	67	38	....	....	......	......
90	Cir.St.	80	Cir.St.	....	....	e	0	n e	2	n e	1	64	38	....	....	......	......
100	St.	....	....	....	....	n e	0	e	1	e	0	72	38	....	....	......	......
..	....	....	....	....	....	s w	1	s w	6	s w	2	74	42	*	....	.02	......
90	St.	....	....	....	....	n w	8	n	5	n	1	52	24	....	....	......	......
....	....	....	....	....	....	s	1	s	7	s w	3	55	30	....	....	......	......
60	Cir.St.	60	Cir.St.	....	....	s w	4	s w	5	n w	2	65	32	....	....	......	......
10	Cir.	....	....	....	....	s e	2	s e	8	s e	4	57	36	....	....	......	......
....	....	20	Cir.	...	....	s	5	s	7	s	6	67	42	....	....	......	......
10	Cir.	30	Cir.	10	Cir.	s	5	s w	8	s w	9	73	48	*	....	.08	......
90	St.	80	St.	100	Nim.	s e	9	s	12	s	7	70	54	7 p. m.	....	......	......
100	St.	100	St.	....	....	s	6	s w	9	s w	2	65	46	....	2 p. m.	.20	......
30	Cir.St.	50	Cir. Cu.	50	Cir.St.	n w	1	n e	1	s e	4	68	47	....	....	......	......
10	Cir.	10	Cir.	....	....	s e	5	s	7	s	5	71	50	....	....	......	......
70	Cu. St.	20	Cu.	....	....	s w	8	w	8	n w	2	72	37	....	....	......	......
100	St.	100	St.	....	....	n w	1	n w	2	n	1	56	39	....	....	......	......
10	Cir.	30	Cir.	....	....	s e	5	s e	6	s e	7	67	46	....	....	......	......
70	St.	90	St.	100	St.	s	4	s w	1	n w	0	70	58	10:30 am	*	1.25	......
100	St.	90	St.	40	Al.Cu	n e	2	e	2	e	3	66	57	6 a. m.	*	.11	......
10	Cir.	10	Cir.	...	....	s e	10	s e	13	s	11	75	55	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2.77	......
49.4	....	40.0	....	17.9	....	....	....	....	....	....	....	70.1	41.3	....	....	......	......
35.8						....	....	....	....	....	....	....	....	....	....	......	......

* In night.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
T 1......	58	49	44	50⅓	94	100	100	.452	.348	.289	28.872	28.974	29.181	29.009
F 2......	39	55	39	44⅓	91	81	100	.216	.349	.238	29.307	29.387	29.416	29.370
S 3......	35	59	44	46	90	76	84	.183	.380	.241	29.400	29.281	29.196	29.292
S 4......	43	61	50	51⅓	92	83	100	.254	.442	.361	29.058	28.961	28.967	28.995
M 5......	36	51	30	39	90	79	100	.191	.296	.167	29.096	29.044	29.141	29.094
T 6......	31	45	37	37⅔	89	76	100	.155	.228	.221	29.125	29.072	29.027	29.075
W 7......	30	44	33	35⅔	100	84	100	.167	.241	.188	28.996	28.929	28.899	28.941
T 8......	30	34	31	31⅔	100	89	89	.167	.175	.155	28.914	28.930	29.039	28.961
F 9......	27	33	28	29⅓	100	89	100	.147	.168	.153	29.248	29.204	29.209	29.220
S 10......	31	31	32	31⅓	100	100	100	.174	.174	.181	29.170	29.100	29.129	29.133
S 11......	30	35	29	31⅓	100	80	100	.167	.162	.160	29.173	29.164	29.180	29.172
M 12......	31	35	33	33	89	80	100	.155	.162	.188	28.896	28.832	28.841	28.856
T 13......	31	29	24	28	100	100	100	.174	.160	.129	28.597	28.626	28.885	28.703
W 14......	22	25	22	23	100	100	100	.118	.135	.118	29.027	29.029	29.065	29.040
T 15......	17	25	14	18⅔	100	100	100	.094	.135	.082	29.188	29.351	29.513	29.357
F 16......	10	34	29	24⅓	100	89	100	.068	.175	.160	29.660	29.626	29.532	29.606
S 17......	31	36	42	36⅓	100	100	100	174	.212	.267	29.267	29.180	29.090	29.179
S 18......	50	51	39	46⅔	100	100	100	.361	.474	.238	28.941	28.937	29.007	28.962
M 19......	48	56	55	53	100	100	100	.335	.449	.433	28.953	28.907	29.015	28.958
T 20......	57	63	55	58⅓	100	94	100	.466	.543	.433	28.973	28.886	28.781	28.880
W 21......	44	34	32	36⅔	100	79	100	.289	.155	.181	28.598	28.964	29.086	28.886
T 22......	35	48	38	40⅓	90	92	91	.183	.310	.208	28.921	28.668	28.934	28.874
F 23......	28	39	32	33	88	73	100	.135	.173	.181	29.311	29.310	29.369	29.330
S 24......	32	34	32	32⅔	89	100	100	.162	.196	.181	29.340	29.199	29.157	29.232
S 25......	32	32	28	30⅔	100	89	100	.181	.162	.153	29.149	29.153	29.147	29.150
M 26......	26	32	24	27⅓	100	89	100	.141	.162	.129	29.015	29.010	29.086	29.037
T 27......	28	31	33	30⅔	100	100	100	.153	.174	.188	29.119	29.073	29.076	29.089
W 28......	34	35	32	33⅔	89	90	100	.175	.183	.181	29.069	29.076	29.123	29.089
T 29......	30	33	27	30	100	100	100	.167	.188	.147	29.161	29.169	29.248	29.193
F 30......	27	40	35	34	88	91	100	.129	.225	.204	29.167	29.074	29.109	29.117
Sums	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	35.94	96.0	90.1	98.8	.198	.241	.205	....	....	....	29.09
Averages	......	......	......	......	95.0			.215			....	....	....	....

NOVEMBER, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	Cu.St.	....	....	s w	12	s w	17	s w	5	59	34	*	3 p. m.	.19	......
....	....	....	....	10	Cir.	s w	4	w	5	w	1	56	32	....	....	......	......
....	....	....	....	....	....	s w	3	s w	10	s w	10	60	34	....	....	......	......
....	....	....	....	60	Cir.St.	s w	5	s w	8	s w	4	62	34	....	....	......	......
10	Cir.	40	Cu.	....	....	w	3	w	15	n w	2	59	26	....	....	......	......
....	....	100	St.	100	Nim.	s w	3	s w	6	s w	1	48	29	12 m.	*	.15	......
100	St.	60	Cir.St.	40	Cir.St.	w	2	s w	10	s w	4	46	28	2 p. m.	*	.08	Trace
40	Cir. Cu.	100	St.	90	Cu.	w	7	n w	9	n w	6	35	26	1 p. m.	*	.02	.20
90	St.	100	St.	20	Cir.	n	7	n w	6	n	3	34	26	....	....	......	......
100	St.	100	St.	100	St.	s	2	s	6	s e	1	34	29	7 a. m.	*	.18	.60
100	St.	50	Cir. Cu.	....	....	n e	1	n	4	n w	....	36	25	....	....	......	......
100	St.	100	St.	100	St.	s w	4	s w	....	s w	....	37	30	....	....	......	......
100	St.	100	St.	90	St.	e	....	n w	....	n w	....	31	20	*	4 p. m.	.12	1.00
100	St.	90	St.	30	Cir. St.	w	....	w	....	n w	....	26	16	*	9 p. m.	.05	.50
10	St.	....	....	....	....	n w	....	w	....	w	2	26	4	*	*	.40	4.00
....	....	30	Cir.St.	100	St.	s w	1	s w	3	s	6	34	10	....	....	......	......
100	St.	100	St.	100	St.	s e	7	s	5	s w	6	51	30	*	9 p. m.	.04	.40
100	St.	100	Nim.	100	St.	s w	16	s w	6	e	6	52	39	9 a. m.	9 p. m.	.78	......
100	Nim.	100	St.	100	St.	s e	4	s w	8	s w	4	58	45	*	3 p. m.	.64	......
90	Cir.St.	100	St.	100	St.	s	6	s	8	s w	1	64	43	‡	....	1.36	......
100	Nim.	80	Cu. St.	10	Cu.	w	22	w	18	w	6	44	30	7 a. m.	11 a. m.	.01	......
100	Cu. St.	100	St.	50	Cu. St.	s e	12	s	2	w	12	52	25	3 p. m.	4 p. m.	Trace	......
....	....	40	Cir.	....	....	w	1	w	....	n w	....	39	27	....	....	......	......
100	St.	100	St.	100	St.	n e	....	n e	....	n e	5	36	29	§	....	......	......
100	St.	100	Cir.St.	....	....	n e	7	n	6	n	8	33	24	....	9 a. m.	.50	5.00
40	Cir.St.	....	....	....	....	n	6	n w	7	n w	2	33	19	....	....	......	......
100	St.	80	Cir.St.	100	Cir.	s w	4	s e	4	s e	2	34	25	....	....	......	......
100	St.	100	St.	90	St.	s w	....	s w	....	w	....	36	29	....	....	......	......
100	St.	100	St.	....	....	s w	....	n	....	w	....	33	23	†	2 p. m.	......	Trace
....	....	100	Cir.St.	100	St.	s	....	s w	....	w	....	40	26	....	....	......	......
....	....	....	....	....	....	....	....	....	....	....	....	......	......	....	....	4.52	11.70
69.3	....	72.3	....	47.0	....	....	....	....	....	....	....	42.9	27.2	....	....	......	......
62.9						....	....	....	....	....	....	......	......	....	....	......	......

*In night. †Snow in night. ‡In night, 4 a. m., 26; 2 p. m., in night, 1.10.
§Snow, 1 p. m.

METEOROLOGICAL OBSERVATIONS FOR THE MONTH OF

Day of month.	Thermometer, in open air.				Relative humidity, or per cent of saturation.			Pressure of vapor, in inches.			Barometer reduced to freezing point.			
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Mean.
S 1......	33	34	31	32⅔	100	90	100	.188	.183	.174	29.157	29.170	29.193	29.173
S 2......	27	34	33	31⅓	100	90	100	.147	.183	.204	29.251	29.193	24.168	29.204
M 3......	35	40	38	37⅔	90	91	100	.191	.235	.229	29.159	29.115	29.104	29.126
T 4......	37	38	34	36⅓	91	100	100	.208	.229	.196	28.902	28.784	28.821	28.869
W 5......	34	37	33	34⅔	100	91	100	.196	.208	.188	28.938	29.019	29.168	29.042
T 6......	32	39	34	35	100	91	100	.181	.225	.196	29.211	29.151	29.157	29.173
F 7......	33	33	28	31⅓	100	89	100	.188	.175	.153	29.140	29.199	29.276	29.205
S 8......	25	34	35	31⅓	100	90	81	.135	.183	.178	29.210	29.005	28.833	29.016
S 9......	20	20	15	18⅓	85	85	100	.096	.096	.086	29.227	29.262	29.397	29.295
M 10......	17	23	20	20	100	100	100	.094	.123	.108	29.303	29.299	29.274	29.292
T 11......	18	20	14	17⅓	100	100	100	.098	.108	.082	29.198	29.205	29.274	29.226
W 12......	15	32	36	27⅔	100	89	90	.086	.169	.199	29.151	28.819	28.720	28.897
T 13......	26	24	11	20⅓	100	100	100	.141	.129	.071	28.953	29.097	29.314	29.121
F 14......	6	11	15	10⅔	100	100	100	.057	.071	.086	29.463	29.458	29.513	29.478
S 15......	13	22	8	14⅓	100	100	100	.078	.118	.062	29.587	29.545	29.603	29.578
S 16......	5	27	23	18⅓	100	100	100	.055	.147	.123	29.583	29.509	29.419	29.504
M 17......	25	29	31	28⅓	100	100	89	.135	.160	.162	29.191	29.150	29.177	29.173
T 18......	35	37	37	36⅓	100	100	100	.204	.221	.221	28.954	28.938	29.076	28.989
W 19......	32	45	32	36⅓	100	85	89	.181	.273	.168	29.150	29.117	29.187	29.151
T 20......	30	34	25	29⅔	89	90	100	.155	.183	.135	29.219	29.118	29.168	29.167
F 21......	27	41	37	35	100	83	91	.147	.231	.208	28.959	28.815	28.768	28.847
S 22......	35	49	45	43	81	93	85	.178	.335	.273	28.744	28.726	28.712	28.727
S 23......	45	39	31	38⅓	85	91	100	.273	.225	.174	28.532	28.562	28.705	28.600
M 24......	27	25	24	25⅓	93	100	100	.141	.135	.129	28.829	28.875	28.910	28.871
T 25......	21	21	19	20⅓	100	100	100	.113	.113	.103	28.910	28.930	28.989	28.943
W 26......	9	26	25	20	100	93	100	.065	.135	.135	29.114	29.179	29.214	29.169
T 27......	17	34	28	26⅓	100	89	100	.094	.175	.153	29.205	29.127	29.088	29.140
F 28......	26	26	22	24⅔	100	93	100	.141	.135	.118	29.160	29.163	29.201	29.175
S 29......	20	30	21	23⅔	100	100	100	.108	.167	.113	29.087	28.976	28.922	28.995
S 30......	27	37	32	32	100	86	100	.147	.201	.181	28.789	28.699	28.762	28.750
M 31......	29	23	13	21⅔	100	100	100	.160	.123	.078	28.815	28.919	29.183	28.972
Sums....	......	......	......	......	......	......	......	......	......	......	....	....	....	....
Means....	......	......	......	27.69	97.1	93.8	97.6	.141	.174	.151	....	....	....	29.093
Average.	......	......	......	......	96.2			.155			....	....	....	....

DECEMBER, 1900, AT AGRICULTURAL COLLEGE, LANSING, MICHIGAN.

Clouds.						Winds.						Registering thermom'r.		Rain and snow.			
7 A. M.		2 P. M.		9 P. M.		7 A. M.		2 P. M.		9 P. M.							
Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Per cent of cloud.	Kind.	Direction.	Force.	Direction.	Force.	Direction.	Force.	Maximum.	Minimum.	Beginning, rain or snow.	Ending, rain or snow.	Inches of rain or melted snow.	Depth of snow, inches.
100	St.	100	St.	....	....	n w	....	n w	....	w	....	35	27	....	....	......	......
20	Cir.	20	Cir.	70	St.	s	....	s	9	s	6	40	28	....	....	......	......
100	St.	100	St.	100	St.	s w	3	w	4	w	1	40	35	....	....	......	......
100	St.	100	St.	100	St.	w	2	w	5	n w	....	38	33	1 p. m.	6 p. m.	.07	......
100	St.	80	Cu. St.	100	St.	w	....	w	....	n w	....	38	31	*7 a. m.	*3 p. m.	Trace	Trace
100	St.	60	Cir.	100	Cir.St.	s w	....	s	8	s e	1	40	31	....	....	......	......
100	St.	100	St.	100	St.	n e	7	n e	7	n e	5	33	24	†	3 p. m.	.11	......
100	St.	90	Cu. St.	90	Cu. St.	w	6	s w	17	s w	16	38	18	....	....	......	......
50	Cu. St.	40	Cu. St.	50	Cu. St.	w	9	w	12	n w	7	22	14	Snow	flurries	......	......
60	Cir.St.	40	Cu.	....	....	s w	5	w	8	w	5	24	16	In	night.	.02	.20
100	St.	90	St.	30	St.	w	4	n w	10	w	....	23	12	Snow	flurries	......	......
10	Cir.	10	Cir.	100	St.	s	....	s	20	s w	17	37	14	....	....	......	......
90	St.	50	Cu. St.	....	....	w	9	n w	12	n w	2	26	4	Snow	flurries	......	......
30	Cir.	70	Cir.St.	100	St.	n	2	n e	3	e	3	17	6	....	....	......	......
90	Cu. St.	30	Cu.	....	....	n e	6	n e	2	n e	1	23	2	....	....	......	......
....	....	....	....	30	St.	e	3	s e	9	s e	11	27	5	....	....	......	......
100	St.	100	St.	100	St.	s e	7	s e	4	s e	2	35	24	†	3 p. m.	.09	.90
50	Cir.St.	100	St.	100	St.	s	9	s w	12	s w	7	38	31	9 a. m.	....	Trace	......
....	....	20	Cir.	....	....	s w	5	s w	11	w	7	46	29	....	....	......	......
50	Cir.	20	Cir.	....	....	n w	3	w	2	w	2	35	24	....	....	......	......
60	Cir.St.	20	Cir.	30	Cir.	s	....	s	....	s	...	42	26	....	....	......	......
20	Cir.	100	Cir.St.	60	Cir.St.	s	....	s	11	s	12	51	34	....	....	......	......
100	St.	100	St.	100	St.	s	13	s w	19	s w	19	49	26	†	11 a, m.	.06	......
100	St.	90	Cir.St.	90	St.	s w	17	s w	16	s w	11	27	20	....	....	......	......
100	St.	100	St.	90	St.	s w	8	w	12	w	10	21	9	In	night.	.05	.50
.	... .	70	Cir. Cu.	90	St.	w	1	w	4	w	8	26	9	....	....	......	......
20	Cir.	30	Cir.	40	Cir.St.	s w	7	s w	8	s w	2	34	17	....	....	......	......
100	St.	90	St.	90	Cir.St.	n	4	w	8	s w	9	28	16	....	....	......	......
....	....	....	....	....	....	s w	12	s w	16	s w	15	31	19	....	....	......	......
100	St.	30	Cir.	100	St.	s w	11	s w	14	s w	6	38	27	....	....	......	......
100	St.	100	St.	70	Cu. St.	n	2	n	4	n	1	29	11	‡	11 a. m.	.10	.100
...	....	....	....	...	....	....	....	....	....	....	....	....	....	....	....	.70	2.60
66.1	....	62.9	....	63.2	....	...	...	...	...	...	...	33.3	20.1	....	....	......	......
64.1						....	....	....	....	....	....	....	....	....	....	......	......

* Snow. † In night. ‡ Snow in night.

BULLETINS

OF THE

AGRICULTURAL COLLEGE EXPERIMENT STATION

ISSUED DURING THE

YEAR ENDING JUNE 30, 1901

EXPERIMENT STATION BULLETINS.

REPORT OF THE UPPER PENINSULA EXPERIMENT STATION FOR THE YEAR 1900.

President J. L. Snyder:

I have the honor to submit herewith, the first report of the work accomplished at the Upper Peninsula Experiment Station, to be printed as No. 186 of Experiment Station bulletins. This report includes, first an introductory article giving the law establishing the Station, and its history to date; second a report of the work done at the Station, by Leo M. Geismar, the Superintendent; third, a report on the geology and botany of the Station by C. F. Wheeler, the Station Botanist, and, finally, a report as to the insect and animal life found in the vicinity of the Station by R. H. Pettit, the Entomologist of the Station.

Yours respectfully,
CLINTON D. SMITH,
Director.

THE UPPER PENINSULA EXPERIMENT STATION.

BY CLINTON D. SMITH, DIRECTOR.

The State Legislature at its regular session, beginning January, 1899, passed an act appropriating $5,000 for the establishment and maintenance of an Experiment Station in the Upper Peninsula. A copy of that act follows:

The People of the State of Michigan enact:

Section 1. That the members of the official board of the Agricultural College of this State shall ex-officio constitute a board of locating and building commissioners for the purpose of selecting a site and erecting the necessary buildings thereon for a State Agricultural and Horticultural Experiment Station in the Upper Peninsula.

Sec. 2. The said board of commissioners may receive by donation within six months from and after the approval of this act in some portion of the Upper Peninsula which seems to them most suitable for the above mentioned purpose a tract of land containing not less than eighty acres.

Sec. 3. That the deed for such site shall be duly executed to the people of this State and delivered to the Auditor General.

Sec. 4. If, after the selection of such site, it be found necessary, the said board shall have power and it shall be their duty to procure and adopt plans, specifications and estimates and to erect suitable buildings thereon and the said board shall carry on such experiments pertaining to agriculture and horticulture as in their judgment will be most beneficial to the agricultural interests of the Upper Peninsula, and they shall have full control of the management of said Experiment Station: Provided, however, That the entire cost of said buildings shall not exceed the sum of $2,500.

Sec. 5. Upon the adoption of plans and specifications by said board, they shall advertise for a time not less than four weeks in such papers as they may select in said Upper Peninsuda for proposals for constructing said buildings in accordance with the plans and specifications. All contracts for labor or materials to be used in the erection and construction of the buildings provided for by this act requiring an expenditure of more than $300 shall be let to the lowest bidder or bidders, the advertisement thus provided for to specify the time and place where the bids or proposals made in pursuance thereof shall be opened; all bids or proposals thus made shall be sealed and shall not be opened at any time or place other than that designated in the advertisement; all or any bids or proposals received by said board may be by them rejected and whether accepted or rejected shall after decisions thereon by said board be deposited in the office of the Secretary of State.

Sec. 6. In letting contracts, said board shall not obligate the State to pay to any contractor any money other than that to which said contractor may be justly entitled by reason of labor or materials already furnished or supplied, and in no event shall more than seventy-five per cent of the amount called for in any contract be paid to the contractor named therein before the completion of his contract and its acceptance by said board: Provided, That every contractor performing service or work or furnishing materials under this act shall enter into such bonds with sureties for the proper performance of his contract as shall be required by the board of commissioners.

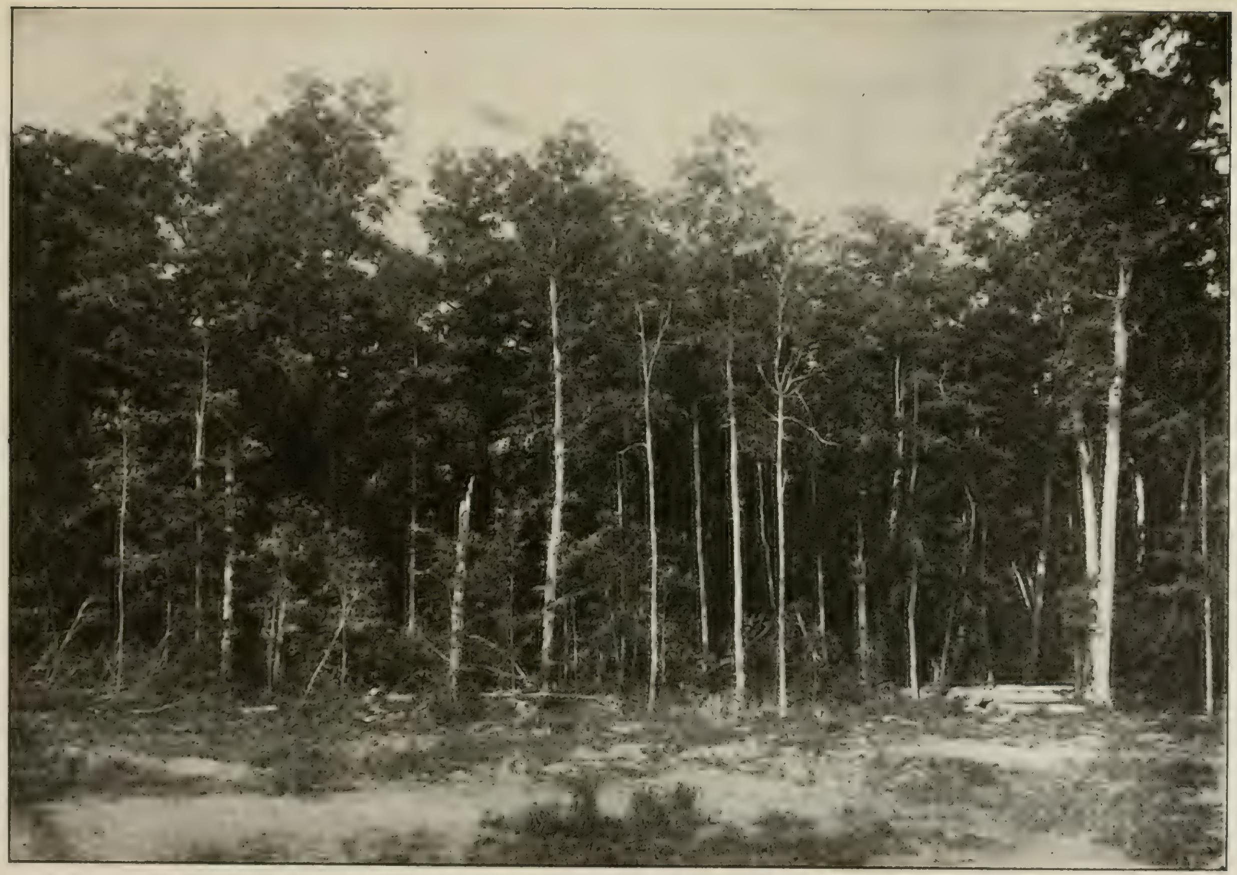
Sec. 7. Each of the members of said board of locating and building commissioners shall be entitled to receive his actual traveling expenses in the discharge of his duties under this act.

Sec. 8. And there is hereby appropriated for the purpose of carrying out the provisions of this act the sum of $5,000 and the same shall be incorporated in the State tax as follows, to wit: For the year 1899, $2,500; for the year 1900, $2,500, and the sums when collected shall be placed by the Auditor General to the credit of said Experiment Station fund and may be drawn by the treasurer of said board upon warrants made by their secretary and approved by the president of said board. And the treasurer above mentioned is hereby required to give his bond to the people of this State in the penal sum of double the amount that is liable to come into his hands under the provisions of this act. The amount of said bond to be determined by said board.

Sec. 9. It shall be the duty of the secretary of said board to render semi-annually to the Auditor General accounts current of all cash transactions and all moneys received, with the proper vouchers, and no money shall be drawn by virtue of this act by said board unless they shall have first filed with the Auditor General an estimate and statement showing the purpose for which money is required, also have made the semi-annual account of all moneys previously drawn.

Late in July, 1899, the State Board of Agriculture, obeying the mandate of this law made a rapid survey of some of the agricultural sections of the Upper Peninsula and chose as the site of the Upper Peninsula Experiment Station the 160 acres constituting the southeast quarter of Sec. 28; range 46 north; 21 west.

This tract lies along the Munising railroad at Chatham, eighteen miles south and west of Munising, in Rock River township, Alger county. It lies eight miles south of Au Train Bay, on the south shore of Lake Superior, and from 250 to 300 feet above its level. The farm is practically surrounded by a large belt of hardwood timber and the climatic conditions are similar to those existing over the major portion of the central section of the Upper Peninsula. Heavy snow covers the ground during the relatively long winters, preventing deep freezing of the soil. The snow lies on the ground continuously during the winter and until late in the spring when the sudden oncoming of the warm weather forces a rapidity of growth in the vegetable world unknown in regions farther south. The summers are hot and moist with no severe drouths. The autumns are long and usually delightful, although in areas surrounded by forests there is always danger of late frosts in the spring and early frosts in the fall, except along the shores of the great lakes. This danger, however, disappears with the removal of the forests.



The Experiment Station as it appeared May 1, 1889, heavily timbered with maple.

The soil on the tract selected is far from homogeneous. Near the little creek, which flows east and west through the center of the 160 acres and divides the tract into two approximately equal parts, there is an area of black muck, while on the terraces, which rise one above another on either side, the soil is graded into a black sandy loam, containing plenty of lime and of great native fertility. This soil is spread rather thinly over the solid rock. The valley of the stream, which is known by the name of Slap Neck Creek, is approximately sixty-five feet deep, measuring from the surface of the water in the creek to the level of the upper terraces on each side. These terraces are bounded by gentle connecting slopes, all cultivable. The depth of the soil varies from two and one-half to three and one-half feet. The native timber is maple, for the most part, with a few basswood, cedar, wild cherry and elm. The large size of the trees, combined with the denseness of the forest, demonstrates the good quality of the land. The contour of the surface provides ample drainage, except in time of excessive rainfalls.

An analysis of the underlying rock made by Dr. R. C. Kedzie, the chemist of the Experiment Station, exhibits the following composition:

Carbonate of lime	32	per cent
Carbonate of magnesium	22	" "
Sand	35	" "
Iron and aluminum oxides	5	" "
Water and undetermined	6	" "
	100	

The upper strata of these rocks are exceedingly soft and friable. The soil is composed of this rock disintegrated in place and mixed with decaying vegetable matter.

The 160 acres of land on which the Station is located was donated to the State by the Munising Railroad Company. This company also agreed to clear, stump and grub the land as needed for experimental purposes and specifically agreed to clear, stump and grub twenty acres prior to May 1, 1900.

After accepting the donation of the land, the State Board of Agriculture confided the planning and execution of experiments to the Director and Council of the Experiment Station, connected with the Agricultural College.

Mr. Leo M. Geismar, then of Reed City, was appointed Superintendent in charge in the spring of 1900.

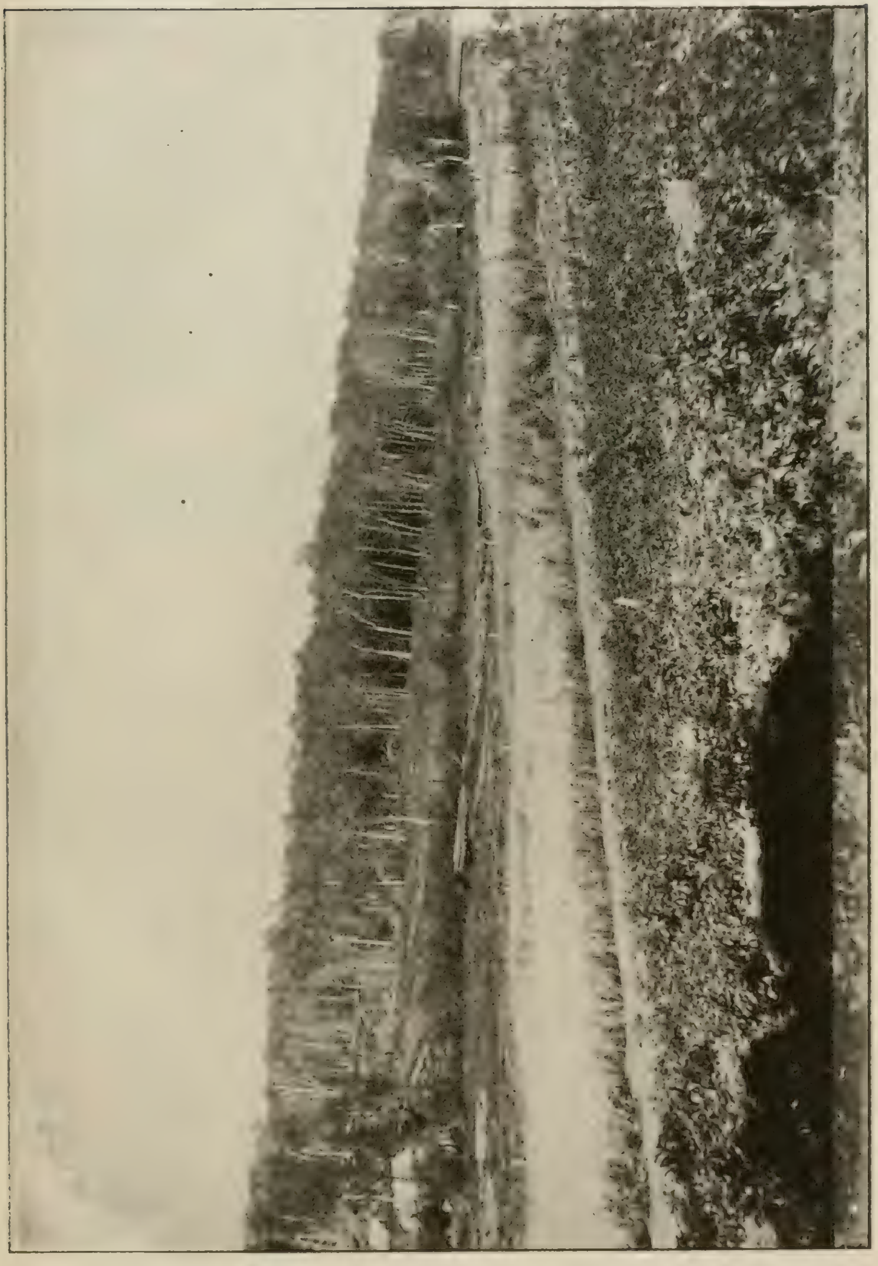
Owing to the unusual lateness of the spring, and the superabundance of rain, combined with the scarcity of men in the entire Upper Peninsula, due to the high price of lumber, the work of clearing the land was greatly delayed. It was not until well toward the middle of May that enough land had been cleared to make possible the planting of a single plot. It was then too late to begin tests the results of which would be based on the comparison of yields of adjacent plots. All that could be done was to test the growth and behavior of our common cereals, vegetables and fruits, in that northern climate, select the varieties best adapted to the conditions existing there, and in general determine the basis for future experiments. The selection of varieties of cereals and other field crops was made by Prof. J. D. Towar, the Agriculturist of the Station, who imported much of the seed from either northern Canada or the northern United States, introducing not only the varieties suited to northern Michigan, but the strains of those varieties which had been cultivated in the northern climates long enough to become thoroughly acclimated.

A beginning has been made with vegetables, small fruits and tree fruits, the varieties being selected by Professor L. R. Taft, the Horticulturist of the Station, the plants and seeds furnished by him and the work carried forward by Superintendent Geismar.

The Superintendent was greatly handicapped throughout the season, first by an almost continuous downpour of rain, which not only delayed the starting of crops at the proper time in the spring but prevented the cultivation subsequently; second, by the depredations of deer, against which the Station farm was not provided with suitable fencing; third, the difficulty of obtaining help; fourth, and finally, the absence of buildings wherein could be stored either the tools or the yields of the various plots.

During the late summer and fall the last difficulty was remedied by the construction of a suitable house and barn.

A substantial fence has been put around the cleared plots to exclude animals.



General view of the cleared portions of the Station grounds.

A road runs north and south along the east line of the farm. The areas cleared are adjacent to this road. South of the creek, and including part of the muck bed which borders the stream, two acres and a half have been cleared and used for the celery beds and part of the turnips and other vegetables. South of this cleared space, and adjoining it, an area on the first terrace four hundred feet long by two hundred fifty wide has also been cleared and set out with strawberries and other small fruits, and used for vegetable experiments. On this terrace the apple and other fruit trees have been heeled in and some plots of cereals grown.

North of the creek the site for the buildings was located on a terrace some fifty feet higher than the creek and four hundred fifty feet north of it. North of this building site an area of four acres, approximately, was cleared early in the spring, and upon this four acres were carried on the experiments with potatoes, corn and most of the cereals. Additional areas have been cleared north and west of these plots.

It would be manifestly out of place in a report of this kind to go into a detailed description of the agricultural resources of the Upper Peninsula. Of the fifty-eight thousand, nine hundred fifteen square miles constituting the area of the State, approximately two-fifths is included within the boundaries of the broad triangle of the Upper Peninsula. Of this large area no small proportion is first-class farming land, well adapted by soil fertility and climatic conditions to the growing of root crops, small fruits, stone fruits, apples, oats, barley, wheat, the grasses and clover. The proximity of the great mining districts and the lumber camps insures a regular and active market. High prices for agricultural products are certain for many years to come.

The great variety of soils, from the heavy clays and clay loams of Chippewa county, the muck beds and black prairie soils about Rudyard, Newberry and scattered over all parts of the peninsula, to the rich loams of Delta and Menominee counties insures a satisfactory farm to the seeker, no matter what his choice of soil may be. A brief statement concerning the soils of the Upper Peninsula, kindly furnished by the State Geologist, A. C. Lane, and included in this bulletin, gives a comprehensive view of the soil conditions obtaining north of the straits.

FIELD CROPS, VEGETABLES AND FRUITS.

UPPER PENINSUA EXPERIMENT STATION.

LEO M. GEISMAR, SUPERINTENDENT.

The season of 1900, in the central portion of the Upper Peninsula of Michigan, was characterized by an excessive rainfall well distributed through the season, excepting the week beginning August 12. The following table gives the rainfall, beginning Sunday morning in each case, since July 8, when observations were first taken at this Station, until September 30, the end of the growing season:

RAINFALL.

Day of month.	July.	August.	Sept.
1		.00	.00
2		.00	.44
3		.00	.15
4		.00	.00
5		.00	1.55
6		.15	.77
7		.45	.00
8	.02	.98	.00
9	Trace.	.79	.00
10	.12	Trace.	.55
11	.25	.10	2.30
12	Trace.	.00	.00
13	Trace.	.00	.00
14	.39	.00	.00
15	.18	.00	.00
16	.34	.00	1.10
17	.78	.00	.04
18	.00	.00	.00
19	.18	.29	.13
20	.03	.19	.21
21	.00	.00	.15
22	.00	.00	.30
23	.25	.03	.22
24	.00	Trace.	.14
25	.03	.00	.11
26	.00	.00	.17
27	.00	.10	.20
28	.00	.04	.24
29	.60	.00	.06
30	.00	.00	
31	.06	.00	

Rainfall by weeks.	
July 14	.78
" 21	1.51
" 28	.28
August 4	.66
" 11	2.47
" 18	.00
" 25	.51
September 1	.14
" 8	2.91
" 15	2.85
" 22	1.93
" 29	1.14
Total	15.18

Temperatures have ruled high and autumn frosts have been delayed much later than normal. The following table gives the mean temperatures for the season:

TABLE OF MEAN TEMPERATURES.

Date.	Range.	Date.	Range.	Date.	Range.
July 8	59.5	August 5	81.5	September 2	68
" 9	59	" 6	74.5	" 3	65
" 10	57.5	" 7	78.5	" 4	62
" 11	*	" 8	79	" 5	68.5
" 12	*	" 9	74.5	" 6	54.5
" 13	*	" 10	80	" 7	50
" 14	*	" 11	70	" 8	59
" 15	65.5	" 12	62	" 9	56
" 16	57	" 13	64.5	" 10	60
" 17	54.5	" 14	71.5	" 11	60
" 18	65.5	" 15	74.5	" 12	60
" 19	64	" 16	74	" 13	58
" 20	57	" 17	71	" 14	47.5
" 21	58	" 18	71	" 15	60
" 22	71.5	" 19	75	" 16	56
" 23	63	" 20	67	" 17	54
" 24	67	" 21	67	" 18	44
" 25	58.5	" 22	63	" 19	54
" 26	53.5	" 23	72	" 20	55.5
" 27	66	" 24	67.5	" 21	51.5
" 28	74	" 25	67	" 22	60
" 29	65.5	" 26	74	" 23	58.5
" 30	63	" 27	76.5	" 24	62
" 31	69.5	" 28	65.5	" 25	70
August 1	68.5	" 29	58.5	" 26	55.5
" 2	59	" 30	71	" 27	52
" 3	64	" 31	79	" 28	52.5
" 4	77	September 1	74	" 29	58.5

*Maximum thermometer out of order.

Two light frosts, slightly damaging on low ground the leaves of tender plants, occurred on September 18 and 26 and the first killing frost on October 8.

EXPERIMENTAL CROPS.

SOUTH SIDE PLOTS.

OATS.

As soon as enough ground had been cleared to make the sowing of any crop possible, the oats were put in. Three varieties were tested on plots two by five rods each. These varieties were the Big Four, Black Russian and the Golden Beauty. The seed germinated quickly and the young plants grew luxuriantly notwithstanding the excessive wetness of the season.

The variety, Big Four, was sown on May 17; it was harvested on August 28; it was then 4 feet and 4 inches high and yielded 43 bushels per acre. Strong growing variety to be recommended for this part of the Upper Peninsula.

The variety, Black Russian, was sown on May 17; it was harvested on August 28; was then 4 feet and 2 inches high and yielded 34 bushels per acre. Fairly good growing variety, but least able to withstand excessive rains.

The variety, Golden Beauty, was sown on May 18; it was harvested on August 28; was then 4 feet and 6 inches high and yielded 51 bushels per acre. Strongest growing variety among those tested and to be highly recommended. All varieties were affected by rust due to extremely wet weather, the black suffering more than the white varieties.

BARLEY (On Plots 2x5 Rods).

Varieties of barley tested were the Manshury, 6-rowed, and the Royal, 2-rowed.

The variety, Manshury, was sown on May 17, and was harvested on September 4. It was then 3 feet and 6 inches high and yielded 32⅔ bushels per acre. Strong growing variety and good yielder under normal conditions. The variety, Royal, was sown on May 18; was harvested on September 4; was then 3 feet and 2 inches high and yielded 28 bushels per acre. This variety being sown on lower ground suffered more from excessive rains which caused both varieties to ripen unevenly.

SPRING RYE (On Plots 2x5 Rods).

Spring rye was sown on May 17; was harvested on August 23; was then 5 feet 9 inches high and yielded 29 bushels per acre. Slow in ripening for having been sown late, and badly affected by ergot.

SPRING WHEAT (On Plots 2x5 Rods).

The varieties of spring wheat tested were Wellman's Fife and Stanley.

The Wellman's Fife was sown on May 17; was harvested on September 7; was then 5 feet and 4 inches high and yielded 29 bushels per acre.

The Stanley was sown on May 18; was harvested on September 7; was then 5 feet and 2 inches high and yielded 21⅔ bushels per acre.

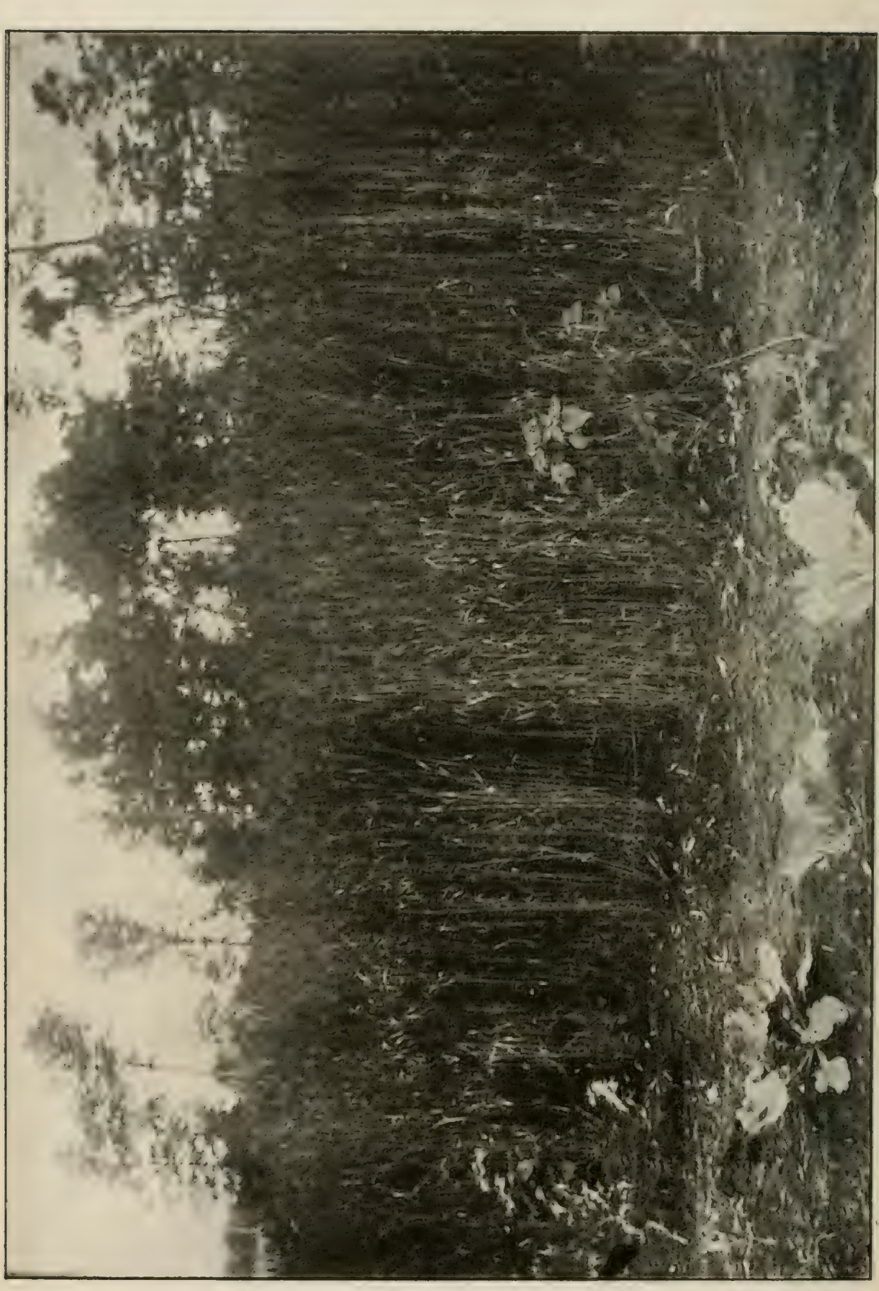
Both varieties, before heading out, showed the effects of excessive rains, being almost red with rust in spots; both, however, showed great power of recuperation, particularly the Stanley, which was sown on very low ground and often stood in four inches of water from two to five days at a time. Both may safely be recommended as strong growers and heavy yielders when grown under normal conditions.

FIELD PEAS (On Plots 2x5 Rods).

The varieties of field peas tested were the Improved Prussian Blue and the Black Marrowfat varieties.

The Improved Prussian Blue variety was sown on May 17; harvested on September 5. The vines were then 10 feet long and the yield was 42 bushels per acre.

The Black Marrowfat was sown on May 17; harvested September 5. The vines were then 10 feet long and the yield was 34 bushels per acre. Wet weather caused both varieties to blossom until harvest time. Both may be recommended as very strong growers and both were entirely free from insects. The fact that the Black Marrowfat was sown on much lower ground may acocunt for the difference in yield.

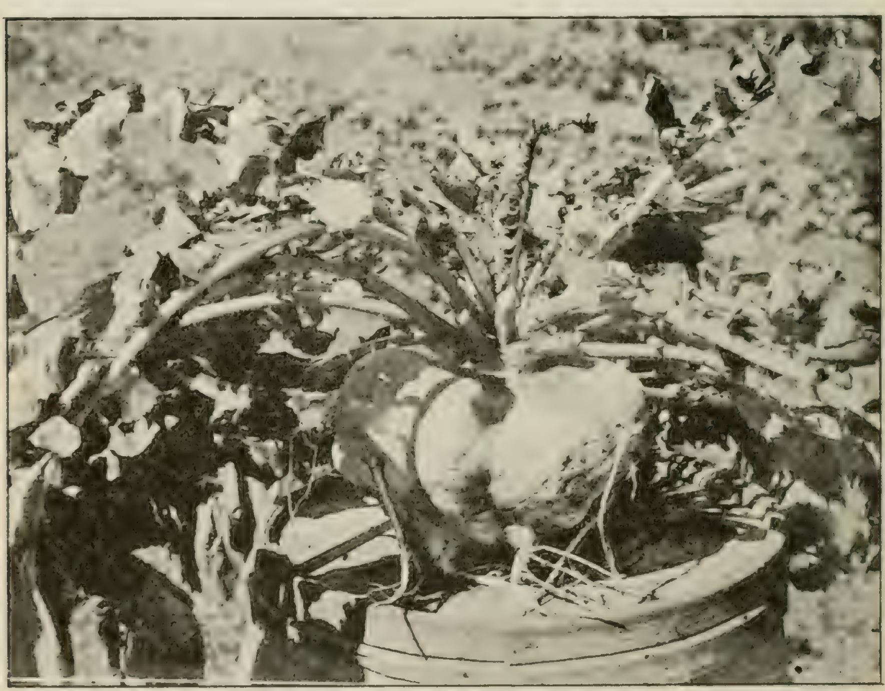


Wellman's Fife Spring Wheat, sown May 17, harvested September 7, yield 29 bushels per acre, 5 feet 4 inches tall.

Improved Russian Blue Field Peas, sown May 17, harvested September 5, yield 42 bushels per acre, vines 10 feet tall.

BEETS, MANGELS, CARROTS, PARSNIPS, SALSIFY, LETTUCE, RADISHES, CABBAGE, ONIONS, SUGAR BEETS, PURPLE TOP, WHITE, YELLOW AND SWEDISH TURNIPS.

Except cabbage and onions, which were planted in rows 250 feet long, all of the crops above mentioned were sown between the rows of fruit trees and fruit bushes, in plots four by fifty feet each, three rows in each plot. All were sown on May 22, 23 and 24. Ten plots were entirely destroyed by cutworms, namely: The Prize Purple Top Swede, subsequently replaced by the same variety June 23, the Mammoth Long Red mangel, replaced June 25 by Jumbo Swede, the Intermediate mangel replaced June 25, by Jumbo Swede, the Giant Globe mangel, replaced by Purple Top Swede June 25, Scarlet Intermediate carrot, replaced June 25 by Purple Top Swede, Mammoth White carrot, replaced June 26 by Jumbo Swede, Giant White Vosges carrot, replaced by Long Red table radishes and lettuce June 25, Improved Short White carrot, replaced June 26 by Jumbo Swede, Danish Improved Red Top beet, replaced June 27 by Jumbo Swede, Golden Tankard mangel, replaced June 27 by Jumbo Swede.



Specimen Turnip, yield 785 bushels per acre.

One plot of Mammoth Long Red mangels was entirely destroyed by deer and the following plots were partially destroyed: Beets, Eclipse and Bassano; mangel, Perfection; stock beet, Danish Improved, and sugar beet, White Silesian.

The following plots on low, undrained ground, were partially destroyed by excessive rains: Turnips, White Swede, Hartley's Bronze Top, Empress and one plot each of Yellow Aberdeen, Swede Jumbo and Purple Top Swede. Including these six plots and the five partially destroyed by deer, the entire twenty-eight plots gave a total yield of 104½ bushels, being a yield of about 785 bushels per acre.

The following list gives the names of the varieties sown, the yield of each plot and the yield per acre for each plot:

No.	Variety.	Name.	Yield in bushels.	Yield per acre.
1	Turnip	White Swede	2½	544
2	"	Empress Swede	2½	544
3	"	Hartley's Bronze Top	3	653
4	"	Red Top Strap Leaf	5	1,089
5	"	Prize Purple Top Swede	3½	762
6	Parsnip	Hollow Crown	2	435
7	Salsify	Long White	1	218
8	Turnip	Prize Purple Top Swede	3½	762
9	Beets	Eclipse	2	435
10	"	Bassano	3¼	707
11	Turnip	Purple Top Swede	4¼	925
12	"	Jumbo, Swede	4½	980
13	"	Purple Top Swede	4¼	925
14	"	" " "	3½	762
15	"	Jumbo, Swede	4¼	925
16	"	" "	4	871
17	"	Purple Top Swede	4¼	925
18	"	Swede, Purple Top	6½	1,415
19	"	Swede, Jumbo	7	1,524
20	"	Greystone	6¾	1,470
21	"	Yellow Aberdeen	6	1,306
22	"	Purple Top Strap Leaf	4	871
23	"	Yellow Aberdeen	3½	762
24	"	Jumbo, Swede	3½	762
25	Mangel	Perfection	1	218
26	Turnip	Jumbo, Swede	3½	762
27	Sugar Beet	White Silesian	3½	762
28	Stock Beet	Danish Improved	2	435

ONIONS (In Rows 250 Feet Long).

One row of onion sets was planted on May 25. While none attained a large size, those on high ground grew slightly above medium size, developed and ripened fairly well. Most of those on lower ground were worthless. The yield was 1½ bushels.

Two varieties of onion seed were sown on May 26, namely one row each of Red Cracker and Yellow Cracker. Very few merchantable bulbs were raised from either variety. Both varieties, as well as those raised from sets, were considerably damaged by maggots.

CABBAGE (In Rows 250 Feet Long, 3½ Feet Apart).

Cutworms and green cabbage worms did considerable damage to both the early and late variety. Excessive rains did less damage to the early variety planted on higher ground. The late variety was planted on the lowest ground of the south side plots and the yield cannot be considered more than 20 per cent of a normal crop.

One row of the early variety was planted on May 23 and ripened from August 15 to 20. The yield was 230 lbs., making a yield of 7 tons per acre. Five rows of the late variety were planted on June 19 and ripened very slowly after September 25. The yield was 320 lbs., giving an approximate yield of barely 1¾ tons per acre.

CELERY (In Rows 350 Feet Long).

Two varieties were planted June 20 on low bottom land, namely one row of Golden Self-Blanching and one row of White Plume. From shortly after planting until bleaching time the ground remained in a condition unfit for cultivation, the plants often standing in water from two to five days at a time, although the ground had been well prepared and thoroughly loosened by plowing twelve inches deep. The Golden Self-Blanching became practically valueless. The White Plume remained undersized, except a small portion of it on slightly elevated ground, which attained a height of 26 to 30 inches. The abnormal weather conditions did not otherwise affect the plants which possessed that rich flavor characteristic of northern climates.

Oats, Cabbage, Celery.

POTATOES (18 Inches Apart, 4 Feet Between Rows).

Eight varieties of potatoes were planted on May 27, 28 and 29, with 3 to 5 eyes in each hill. Shallow cultivation was kept up until the first week in July, when on account of excessive rains, the hills were ridged just enough to leave a deep furrow in the center of each row. Potato beetles were not very numerous, requiring one spraying for the first brood and four for the second. On account of excessive rains all varieties commenced to show signs of leaf blight during blossoming time, and subsequently became seriously affected. All were entirely free from scab. They were harvested September 12, 15 to 20 per cent of the crop having rotted on account of the heavy rains during the preceding ten days. An additional loss of 10 per cent must be ascribed to seed rotting before germination on account of excessive rains, and to plants dying soon after germination, on such places where log heaps had been burned shortly before planting time and had left the ground saturated with an excess of potash. Of the total yield, 3 bushels, or 11 per cent were small and unmerchantable. The following is a list of the varieties planted, giving the yield in bushels of potatoes of merchantable size, the number of hills planted and the yield per acre.

Variety.	Hills.	Yield.	Approximate yield per acre.
Carman No. 1	136	1	56½
Carman No. 3	447	10	168¾
Roberts	216	3	102¼
Harrington Peer	238	5	162
Battles Best	229	4½	142
Mill's Banner	230	4½	141½
Rose of Erin	201	5	179¾
Montana Rose	179	4	161½

STRAWBERRIES, FRUIT BUSHES, GRAPES AND FRUIT TREES.

The first planting done at the Station was the setting out of strawberry plants, fruit bushes and fruit trees, the work beginning May 10. Since no land was cleared on the first day of May, it could not be expected that the ground could be worked into a fit condition to receive plants raised many hundreds of miles south of the Station as early as they should be set out. Strawberry plants were sent earlier than the time set for shipment and arrived a week before the ground was ready. All other fruit varieties were delayed in transit, reaching the Station nearly three weeks after being shipped. A large percentage of them were in a very bad condition, the roots being nearly dried up. New shoots had in some instances grown fully two inches long and dried up again. Many plum and cherry trees had started to blossom. A second shipment of forty fruit trees arrived late in the season in extremely bad order and but eight survived. Careful nursing revived all other trees and plants, and but one plum tree failed to grow. Deep and thorough cultivation followed and was kept up continually until July, great pains being taken not to disturb the roots and but two gooseberry bushes died from improper planting. The excessive rains which followed materially injured all plants, gooseberry bushes being badly affected by mildew and currant bushes but slightly, while all fruit trees suffered from leaf curl and leaf blight; the apples severely, the plums nearly as much, the pears and cherries but slightly. Spraying against insects was made necessary once in each week until July and four more sprayings were applied thereafter. Quite a number of bushes were stunted and over a hundred strawberry plants lingered and finally died from an excessive amount of potash in the soil on the places where log heaps had been burned before planting time. Surface cultivation was kept up during July and the first part of August and fruit trees materially recovered from the effects of leaf blight during the last dry ten days of August. The hastening of wood ripening was rendered useless by the unceasing rains of September.

Fruit trees with rows of vegetables between.

Strawberry plants were set out two feet apart, four feet between rows 400 feet long.

All fruit bushes were planted four feet apart, eight feet between rows 300 feet long.

The sandy loam ground of the north side plots was intended for orchard purpose, but not being cleared at planting time, the fruit trees and grape vines were set out in nursery rows on the clay loam soil of the south side plots and the severer attack of leaf blight upon apple trees must be ascribed to the nature of the soil as much as to excessive rains.

Upon the size of the trees depended the resisting power to abnormal conditions, for while all apple trees survived and many made a splendid growth of new wood, a great number made but a feeble growth, the smaller trees, regardless of variety, faring worse. Out of fifty Shiawassees, for instance, which were small, one-year-old trees, but one made a new growth of sixteen inches, while none of the remaining 49 made a growth exceeding four inches.

If, thriving under adverse conditions may be taken as a safe basis (and no other ground could well be expected as a result of the work of the first season), the following varieties, having made the best growth, should prove desirable.

Strawberries: Seaford, Marshall, Excelsior, Michigan, Sample, the last two being the best.

Gooseberries: Downing, Columbus.

Currants: North Star, Prince Albert.

Raspberries: Loudon, Columbian.

Blackberries: Erie and Eldorado.

Grapes: Early Ohio, Concord.

The following varieties of fruit trees have made a new growth of 20 to 42 inches, those leading among the apple trees being the Haas, with a growth of 32 inches; pear trees: Flemish Beauty, with a growth of 30 inches; plum trees: Forest Garden, with a growth of 34 inches; cherry trees: Brusseller Braune, with a growth of 42 inches.

Apples: Walbridge, Wagener, Wealthy, Yellow Transparent, Gideon, Pewaukee, Duchess of Oldenburg, Tetofsky, Haas, Charlamoff.

Pears: Flemish Beauty, Vermont Beauty.

Plums: Moore's Arctic, Forest Garden, Wyant, Stoddard, De Soto.

Cherries: Lutorka, Brusseller Braune, Dyehouse, Early Richmond, Windsor, Gov. Wood.

EXPERIMENTAL CROPS.

NORTH SIDE PLOTS.

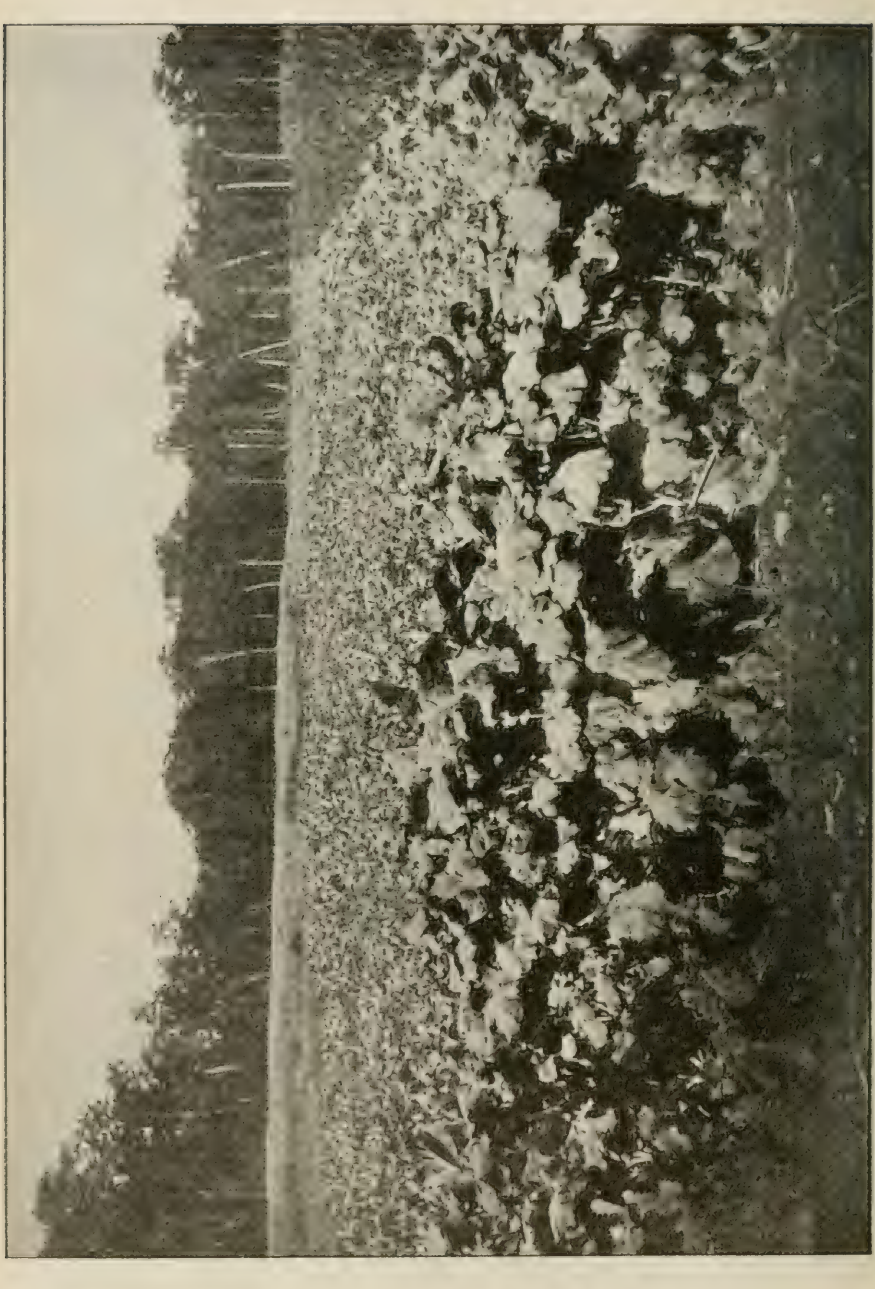
POTATOES (Hills 18 Inches Apart, 4 Feet Between Rows).

Three varieties were planted, one to three eyes in each hill, namely, the Rose of Erin, Roberts and Carman No. 3. Excessive rains did less damage to the plots on account of the better natural drainage and the more porous nature of the soil. Shallow cultivation was kept up, though the hills were slightly ridged during the last week in July with a view to insuring better drainage. But two sprayings for potato beetles were required. Very slight damage resulted from leaf blight, all were practically free from scab and the loss from rot caused by the heavy September rains amounted to less than 5 per cent at harvest time.

Seed destroyed by an excess of potash on places where log heaps had been burned before planting time amounted approximately to 5 per cent for Rose of Erin, 10 per cent for Carman No. 3 and 20 per cent for Roberts. The total yield gave 115¼ bushels of merchantable potatoes and 5 bushels of small potatoes.

"CARMAN NO. 3."

One thousand nine hundred and sixty-nine hills were planted June 3, 4 and 5. The yield was 53½ bushels, or 202½ bushels per acre.



Rape sown June 16, height 36 inches, September 20.

"ROBERTS."

Five hundred and twenty-eight hills were planted June 11. The yield was 8½ bushels, or 127½ bushels per acre.

"ROSE OF ERIN."

One thousand four hundred and ninety-five hills were planted June 12, 13 and 14. The yield was 53¼ bushels, or 259 bushels per acre.

OATS.

Four varieties of oats were sown on June 16, namely, the Goanette Black, the Michigan Wonder, the Rhode Island Rustproof and the Scottish Chief, on plots covering an aggregate surface of 5 by 29 rods. Owing to the lateness of the season they were sown for hay. Excessive rains caused all varieties to rust, the Goanette Black being affected very badly, the Rhode Island Rustproof somewhat less, the Michigan Wonder moderately and the Scottish Chief the least. They were harvested September 18, the Goanette Black being then 28 inches high, the Michigan Wonder 40 inches, the Rhode Island Rustproof 36 inches and the Scottish Chief 38 inches. The yield was 8,250 lbs. or 4½ tons per acre.

RAPE.

One plot of Dwarf Essex rape was sown on June 16, covering a surface of 3 by 22 rods. Aside from slight damage to leaves by cabbage worms the plants grew to perfection, reaching a height of thirty-six inches at the close of the season. The greatest portion of the plot was cut with a mowing machine at various times between September 20 and November 5, the stubble growing new thrifty plants 2 to 6 inches high in spite of the light September and the killing October frosts. The first snow fell on November 7, reaching a depth of 18 inches on November 15. The thermometer had registered as low as 16°, yet on November 16, the new grown plants under the snow, as well as the lower leaves of the old plants on the remaining uncut portion of the plot were apparently unhurt and thrifty, while the leaves above the snow were not seriously damaged. No more profitable crop for sheep can be recommended, nor one better adapted to the Upper Peninsula climate.

PUMPKINS.

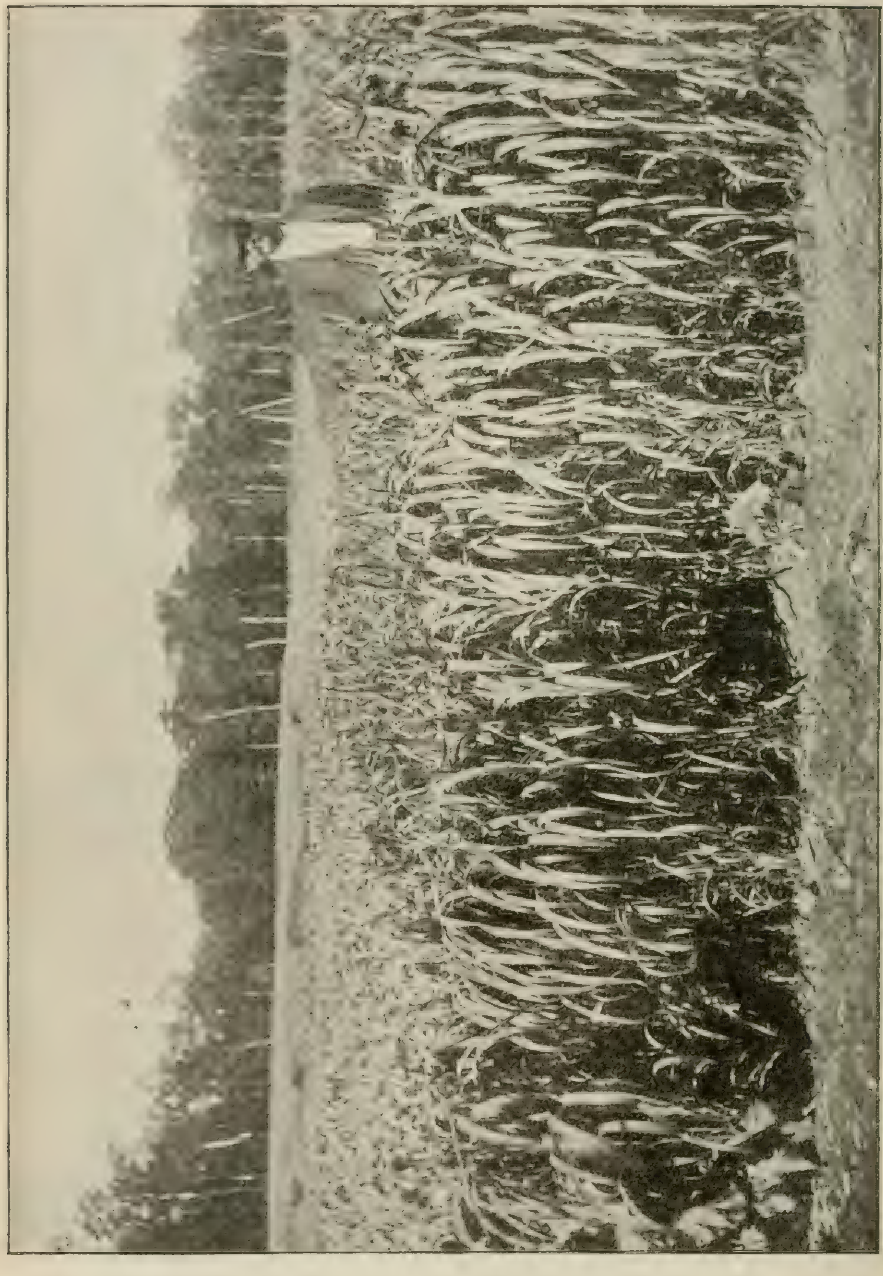
Twenty hills of the Small Sugar variety and 20 hills of the Large Mixed variety were planted on June 6, in hills 8 feet apart each way. Both varieties grew to perfection, unhampered by insects; 60 per cent ripened and the balance nearly so. No attempt was made at growing large specimens and the large variety yielded pumpkins weighing 20 to 25 lbs., while those of the small variety weighed 10 to 12 lbs.

POLE BEANS.

The Early Golden Cluster Wax variety was planted on June 5, the plot covering three rows 150 feet long, 4 feet apart and 2 feet between hills. Fifteen per cent failed to germinate or were destroyed by rabbits and excess of potash. None were allowed to ripen and the light September frosts left them unharmed. About one bushel were on the vines when the plants were killed by frost on October 8. Two and three-quarter bushels were picked between September 12 and October 1, which gives an approximate yield of 66 bushels per acre.

MILLET.

One plot of Japanese Millet was sown on June 18, covering a surface of 1½x22 rods. The entire plot had the best natural drainage and excessive rains did not materially affect it, the plants making a wonderful growth. Next to page 624 of the yearbook of the U. S. Department of Agriculture for 1899 may be seen an engraving representing a plot of this same variety, grown at the United State Grass Experiment Station, Walla Walla (Wash.) and showing it full grown, barely five feet high. The millet grown at this Station, when headed out attained an average height of 6 feet and 8 inches and a great many specimen plants were 7 feet high.



Japanese Millet, sown June 18, height when harvested 6 feet 8 inches, yield 13 tons per acre.

The yield of the plot gave 5390 lbs. of green fodder, being equal to a yield of 13 tons of green fodder per acre. The light September frosts may possibly have arrested its further growth. The coarseness of the straw would indicate, however, that the chief value of this crop will be found in the silo.

CORN (In Hills 4 Feet Each Way).

Six varieties were planted June 7, 9 and 11 on plots 50 feet square, distanced 155 feet apart, namely, two varieties of Dent, three of Flint and one of Sweet corn. Cloud's Early Yellow Dent and Compton's Yellow Flint were planted June 7, Canada Yellow Flint and Gilman's Flint were planted June 9, the Early Butler Yellow Dent and Moore's Early Concord were planted June 11. Shallow cultivation was kept up during the entire season. A very light attack of smut affected all varieties and insects did considerable damage, while excessive rains caused rust to attack all varieties except the Early Butler, which was but slightly affected. Of the two Dent varieties, Cloud's grew to a height of nine feet while the Early Butler averaged ten feet. There is a widespread belief, akin to superstition, that, aside from sweet corn, it would be useless to try to raise corn in the Upper Peninsula. The Cloud and Canada varieties, being planted adjacent to a public highway, curiosity impelled passers-by to strip off most of the ears and to this must be ascribed the smaller yield. The prudent husbandman in regions, even hundreds of miles south of the Station, would not consider it safe to plant corn as late as June 9, yet all varieties were well advanced in the glazing stage at the close of the season, while 10 per cent of the Gilman and 20 per cent of the Compton varieties were thoroughly ripened, the difference in percentage being perhaps due to the topping off process which was resorted to upon one-half of the hills of the Compton variety.

Varieties.	Yield of corn in ears. Bushels.	Approximate yield per acre. Bushels.
Early Butler Yellow Dent	4½	78
Compton's Yellow Flint	3½	60¾
Cloud's Early Yellow Dent	2	34¾
Gilman's Flint	3½	60¾
Moore's Early Concord	9	156
Canada Yellow Flint	1¼	21¾

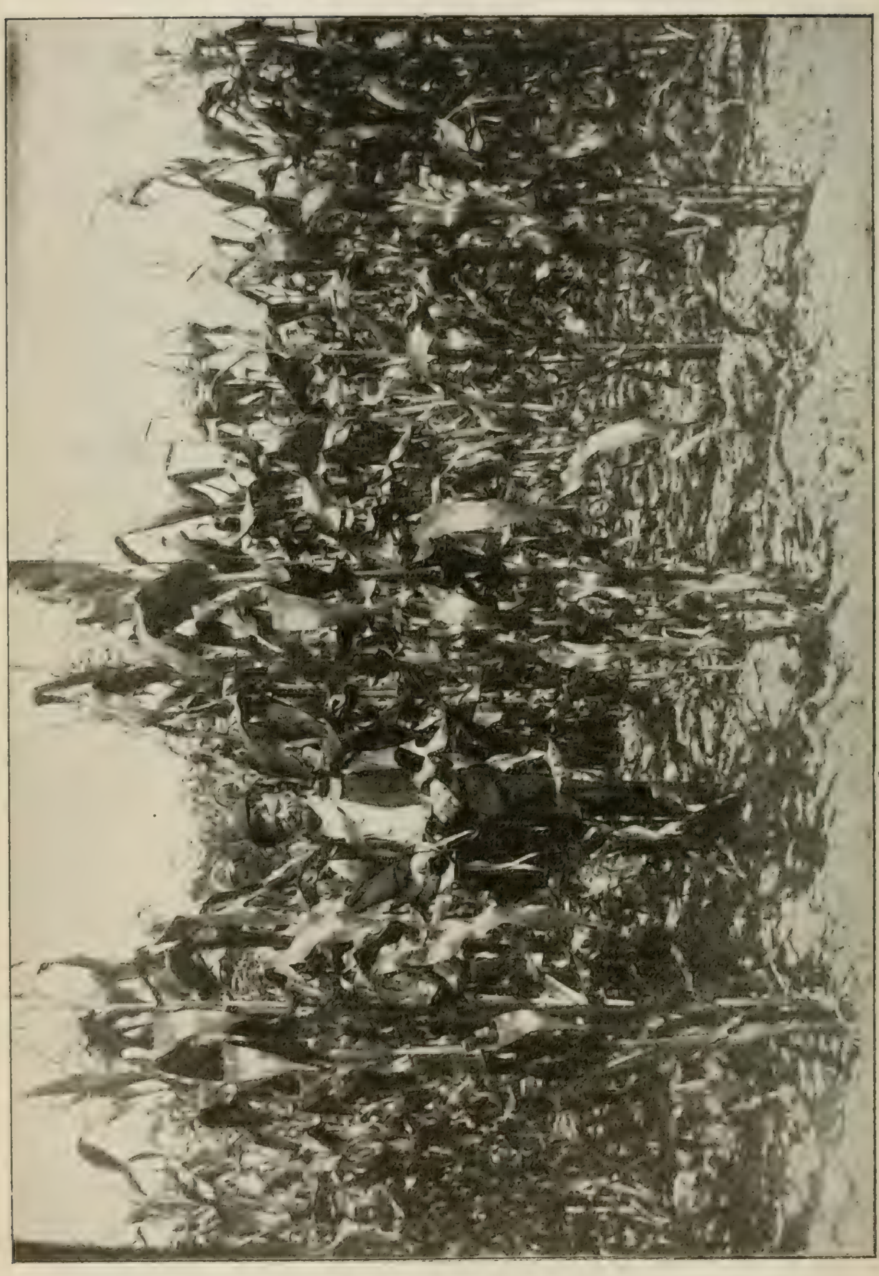
THE GEOLOGY AND BOTANY OF THE UPPER PENINSULA EXPERIMENT STATION.

C. F. WHEELER.

I left the College August 20, in company with Prof. R. H. Pettit, for Chatham, Upper Peninsula, to examine the soil and forest covering of the Sub-Station. Owing to the short time spent in the work a preliminary report only can be made at this time. Collections of flowering plants, ferns, mosses, liverworts and fungi were made and notes on the distribution of the same. Especial attention was given to trees, weeds, plant diseases, and edible fungi, which were very abundant.

LOCATION.

The Sub-Station of the Michigan State Agricultural College Experiment Station is located at Chatham, Rock River township, Alger county, on the southeast quarter section 28, range 46 north and 21 west. The Station land is eight miles south of Lake Superior: twenty-five miles southeast from Marquette and fourteen miles southwest from Munising, and is traversed by the line of the Munising railroad, which cuts off a few rods near the south line.



Early Butler Yellow Dent Corn. Planted June 7, height 10 feet, yield 78 bushels per acre.

TOPOGRAPHY.

Chatham is situated on a plateau about two hundred and seventy-five feet above the level of Lake Superior. The Station land lies in a valley formed by the action of Slap Neck Creek, a rather rapid stream flowing eastward and southward to the Au Train river, into which it empties about six miles away. This creek enters the quarter section near the northwest corner and divides it into two unequal parts. The valley is one-half mile wide and about sixty-five feet deep. The creek has left five distinct terraces since it began to flow at its highest level. However, it is possible that moving ice may have helped in carving out the valley about the time of the last ice flow.

GEOLOGY.

To make the geological conditions plain it will be necessary to state that the eastern portion of the Upper Peninsula from Marquette southward to the Sturgeon river is made up of seven different rock formations, which, beginning on the south shore of Lake Superior are known as—first, the Potsdam sandstone; second, Calciferous sand rock; third, Trenton rocks; fourth, Hudson river rocks; fifth, Niagara rocks; sixth, a very small area of the Onondaga rocks, and seventh, the Helderberg rocks—about St. Ignace and Mackinac Island. These formations represent the oldest sedimentary rocks found in the United States.

For the most part these groups of rocks are covered more or less by the drift, which consists of sands, gravels and clays spread over them during the ice period, when the great northern glaciers covered this portion of North America.

The Station is situated upon the second group of rocks south of Lake Superior, known as the Calciferous sand rock, which here lies in nearly horizontal layers of varying thickness and consistency.

Many of the layers are hard and crystalline and make excellent building stone. The stone for the Munising High School building was taken from an outcrop near the railroad station. This outcrop extends across the south side of the Station grounds. In the lower terraces the outcrop is very friable, easily decomposing into soil of excellent quality. The following extract from the State Geologist, Dr. Alfred C. Lane, may be quoted here as giving a good account of the geological conditions.

"The valley, which is the main topographic feature, is a black muck flood plain, and is bordered by a series of terraces, which are sandy, with black soil tops. The rock is exposed in gutters of the road and elsewhere. On the south side it is a sandy dolomite, and the same formation seems to continue at intervals for a mile south, where there are heavy ledges exposed. On the north side the ledges exposed in the ditch are more calcareous, that is, effervesces more freely in acids, and there are some genuine streaks of clay shales. On the whole, therefore, the site affords a considerable variety of exposure and soil, and while it is rather sandy, it is by no means so light as farther north, and possibly it might be classed as a light sandy loam."

Dr. C. Rominger, State Geologist, in his Report on the Palæozoic Rocks of the Upper Peninsula in 1872, page 107, makes the following statements: "We see at once the greater value of the western districts, which rival any other part of the world in mineral wealth. But I think, too, that the eastern part of the Peninsula has enough of less striking sources of prosperity to make it a precious part of our country and a desirable home for many. Already of high importance are the extended pine lands, which furnish us with excellent lumber, and will do so for a great many years to come, particularly if more care should be taken to prevent the fires which every year destroy thousands of acres of the finest forests."

Not less valuable are the widely extended hardwood lands, stocked with excellent timber for fuel and other purposes, to which up to the present time comparatively little attention has been paid, but which soon will be in demand, with the rapid increase of our iron industry. The ample water power of the rivers, the limestone for the flux, sandstones for the buildings right at hand, and the lakes an open street to all parts of the country, are advantages not found everywhere.

With the clearing of the hardwood lands, a large area of fertile land will be open for tillage. It will be perhaps said that the severity of the climate is an objection to the cultivation of these fertile lands. It is true the winters are much longer there than in the south part of our State, and corn and wheat prove to be very uncertain crops, but potatoes, oats and grass particularly grow as finely there as further south, and the few farmers who have settled here and there seem to be doing very well. The mining districts are always an open, profitable market for their products; the lumber or fur trade is a considerable additional income to them, or gives them employment if they seek it, and those near the lake have a rich harvest in the fisheries. With the increase of inhabitants in these districts, the facilities for all will be improved, and perhaps the time is not far distant when this neglected forest country shall justify the application of our State motto: "Si quæris Peninsulum amœnam, circumspice."

NOTES ON SOME OF THE TREES GROWING IN THE STATION WOODS.

The basswood (*Tilia Americana*) is, or has been, a frequent tree along the outcrop of the Calciferous sand rock. This valuable lumber tree is of large size and excellent quality in this part of Michigan. However, it is rapidly disappearing, as it is now much sought after by lumbermen. An interesting fact is that young trees are springing up everywhere about the old stumps. Many of them are seedlings, and the whole region seems likely to be re-forested in a short time.

The sugar maple (*Acer saccharinum*) is by far the most abundant tree growing on the station grounds. This tree constitutes half of the forest growth in the vicinity of Chatham. The trees are not of large size, ranging from one to two feet in diameter and about sixty feet in height. Some of these trees show signs of disease, and the attempt to turn them into lumber has not thus far been successful. The sugar season is short and the production of maple sugar is not carried on to any great extent.

Red maple (*acer rubrum*). This is a rare tree along the bank of streams.

Black ash (*Fraxinus sambucifolia*). This tree is only seen along streams and in swampy places, accompanying white cedar.

Elm (*Ulmus Americana*). This noble tree is quite common and grows to a large size. One old tree which the lumbermen left, measured twenty-three feet eight inches in girth four feet from the ground. This tree is also rapidly disappearing, being lumbered extensively at the present time.

Beech (*Fagus ferruginea*). Only an occasional tree of small size was seen on the station grounds.

Ironwood (*Ostrya Virginica*). This tree is frequent and reaches a large size in the Alger county woods.

Cherry birch (*Betula lenta*). A frequent tree of good size, but not common enough to yet tempt the lumbermen. The same may be said of the

Yellow birch (*Betula lutea*).

Aspen (*Populus tremuloides*). This is the only poplar noticed in the vicinity of the station, and it is not comomn.

White pine (*Pinus strobus*). Only a few large stumps of this valuable tree were seen.

Balsam fir (*Abies balsamea*). This beautiful tree is scattered throughout the forests, and often reaches a large size.

Hemlock (*Tsuga Canadensis*). This tree, which is so common along the shore of Lake Superior on the sandy ridges is seldom seen at Chatham.

Tamarack (*Larix Americana*). This tree is occasionally seen outside of swamps, where it is abundant and of large size.

White cedar (*Thuga occidentalis*). The white cedar is one of the most valuable trees in the forests of Alger county. It has two places in which it flourishes, viz., large swamps, accompanied by tamarack and black spruce; also in small areas on side hills, where springs come out from the rocks, are many fine specimens of very large size. Here this tree grows in clusters, half a dozen or more trunks branching out from a single root.

LIST OF PLANTS, TREES AND SHRUBS GROWING ON THE STATION GROUNDS.

Moonwort, *Botrychium Virginianum*, Swartz.
Maidenhair, *Adiantum pedatum*, L.
Shield-fern, *Aspidium spinulosum intermedium*, D.C.
Holly-fern, *A. Lonchitis*, Swartz.
Goldie's-fern, *A. Goldieanum*, Hook.
Narrow-leaved Spleenwort, *Asplenium angustifolium*, Michx.
Silvery Spleenwort, *A. thelypteroides*, Michx.

Lady-fern, *A. Felix-foemina*, Bernh.
Bladder-fern, *Cystopteris bulbifera*, Bernh.
Sensitive-fern, *Onoclea sensibilis*, L.
Ostrich-fern, *O. struthiopteris*, Hoff.
Cinnamon-fern, *Osmunda cinnamomea*, L.
Long Beech-fern, *Phegopteris polypodioides*, Fee.
Oak-fern, *P. Dryopteris*, Fee.
Common Horsetail, *Equisetum arvense*, L.
Wood Horsetail, *E. sylvaticum*, L.
Swamp Horsetail, *E. limosum*, L.
Common Scouring Rush, *E. hyemale*, L.
Sedge-like Equisetum, *E. scirpoides*, Michx.
Shining Clubmoss, *Lycopodium lucidulum*, Michx.
White Pine, *Pinus strobus*, L.
White Spruce, *Picea alba*, Link.
Black Spruce, *P. nigra*, Link.
Hemlock, *Tsuga Canadensis*, Carr.
Balsam Fir, *Abies balsamea*, Miller.
Tamarack, *Larix Americana*, Michx.
White Cedar, *Thuya occidentalis*, L.
Ground Hemlock, *Taxus Canadensis*, Willd.
Common Cat-tail, *Typha latifolia*, L.
Bur-reed, *Sparganium simplex*, Hudson.
Indian Turnip, *Arisaema triphyllum*, Torr.
Duckweed, *Lemna minor*, L.
Pondweed, *Potamogeton rufescens*, Schrader.
Pondweed, *P. Richardsonii*, Bennett.
Quack-grass, *Agropyron repens*, Beauv.
Red top, *Agrostis alba*, L.
Hair Grass, *A. scabra*, Willd.
Bottle-brush, Grass, *Asprella Hystrix*, Willd.
Avena Smithii, Porter.
Brachyelytrum aristatum, Beauv.
Brome-grass, *Bromus ciliatus*, L.
Blue-joint, *Calamagrostis Canadensis*, Beauv.
Wood Reed-grass, *Cinna pendula*, Trin.
Wild Rye, *Elymus Virginicus*, L.
Wild Rye, *E. Canadensis*, L.
Nodding Fescue-grass, *Festuca nutans*, Willd.
Meadow Fescue-grass, *F. elatior var, pratensis*, Gray.
Manna-grass, *Glyceria nervata*, Trin.
Squirrel-tail Grass, *Hordeum jubatum*, L.
Millet-grass, *Milium effusum*, L.
Mountain-rice, *Oryzopsis asperifolia*, Michx.
Common Crab Grass, *Panicum sanguinale*, L.
Old-witch Grass, *P. capillare*, L.
Barnyard-grass, *P. crus-galli*, L.
Timothy, *Phleum pratense*, L.
Low Spear-grass, *Poa annua*, L.
English Blue Grass, *P. compressa*, L.
June Grass, *P. pratensis*, L.
Foxtail, *Setaria glauca*, Beauv.
Bottle-grass, *S. viridis*, Beauv.
Sedge, *Carex intumescens*, Rudge.
Sedge, *C. lupulina*, Muhl.
Sedge, *C. retrorsa*, Schwein.
Sedge, *C. Pseudo-cyperus*, L.
Sedge, *C. stricta*, Lam.
Sedge, *C. arctata*, Boott.
Sedge, *C. arctata Faxoni*, Bailey.
Sedge, *C. granularis*, Muhl.
Sedge, *C. laxiflora, striatula*, Carey.
Sedge, *C. Careyana*, Torr.
Sedge, *C. plantaginea*, Lam.

Sedge, *C. varia*, Muhl.
Sedge, *C. communis*, Bailey.
Sedge, *C. pubescens*, Muhl.
Sedge, *C. Backii*, Boott.
Sedge, *C. stipata*, Muhl.
Sedge, *C. vulpinoidea*, Michx.
Sedge, *C. rosea*, Schkuhr.
Sedge, *C. Deweyana*, Schwein.
Sedge, *C. tribuloides reducta*, Bailey.
Sedge, *C. tribuloides Bebbii*, Bailey.
Sedge, *C. cristata*, Bailey.
Sedge, *C. sychnocephala*, Carey.
Sedge, *Cyperus speciosus*, Vahl. (introduced).
Spike-rush, *Eleocharis acicularis*, R. & S.
Spike-rush, *E. intermedia*, Shultes.
Cotton Grass, *Eriophorum atrocinctus*, Fernald.
Common or Soft Rush, *Juncus effusus*, L.
Slender Rush, *Juncus tenuis*, Willd.
Wild Leek, *Allium tricoccum*, Ait.
Smaller Solomon's Seal, *Polygonatum, biflorum*, Ell.
False Spikenard, *Smilacina racemosa*, Desf.
False Solomon's Seal, *S. stellata*, Desf.
Dwarf Solomon's Seal, *Maianthemum Canadense*, Desf.
Twisted-stalk, *Streptopus roseus*, Michx.
Bear-tongue, *Clintonia borealis*, Raf.
Bellwort, *Uvularia perfoliata*, L.
Wake Robin, *Trillium grandiflorum*, Saisb.
Wake Robin, *T. cernuum*, L.
Larger Blue Flag, *Iris versicolor*, L.
Long-bracted orchis, *Habenaria bracteata*, R. Br.
Northern green orchis, *H. hyperborea*, R. Br.
Northern white orchis, *H. dilatata*, Gray.
Shining Willow, *Salix lucida*, Muhl.
Sand-bar Willow, *S. longifolia*, Muhl.
Bebb's Willow, *S. rostrata*, Richardson.
Glaucous Willow, *S. discolor*, Muhl.
Slender Willow, *S. petiolaris*, Smith.
American Aspen, *Populus tremuloides*, Michx.
Balsam Poplar, *P. balsamifera*, L.
Cherry Birch, *Betula lenta*, L.
Yellow Birch, *B. lutea*, Michx. f.
Hoary Alder, *Alnus incana*, Willd.
Beaked Hazel-nut, *Corylus rostrata*, Ait.
Iron-wood, *Ostrya Virginica*, Willd.
Beech, *Fagus ferruginea*, Ait.
White or American Elm, *Ulmus Americana*, L.
Nettle, *Urtica gracilis*, Ait.
Wood-nettle, *Laportea Canadensis*, Gaud.
Small Mistletoe, *Arceuthobium pusillum*, Peck.
Great Water-dock, *Rumex Britannica*, L.
White Dock, *R. salicifolius*, Weinm.
Narrow Dock, *R. crispus*, L.
Bitter Dock, *R. obtusifolius*, L.
Sheep Sorrell, *R. acetosella*, L.
Knot-grass, *Polygonum aviculare*, L.
Pale Persicaria, *P. lapathifolium*, L.
Lady's Thumb, *P. Persicaria*, L.
Common Smartwood, *P. Hydropiper*, L.
Shore Knotweed, *P. littorale*, Link.
Black Bindweed, *P. convolvulus*, L.
Fringed Black Bindweed, *Polygonum cilinode*, Michx.
Maple-leaved Goosefoot, *Chenopodium hybridum*, L.
Lambs' Quarters, *C. album*, L.
Strawberry Blite, *C. capitatum*, Watson.

Pigweed, *Amarantus retroflexus*, L.
Water-Hemp, *Acnida tuberculata*, Moq.
Common Purslane, *Portulaca oleracea*, L.
Night-flowering Catchfly, *Silene noctiflora*, L.
Mouse-eared Chickweed, *Cerastium vulgatum*, L.
Yellow Pond-Lily, *Nuphar advena*, Aiton, f.
Common Virgin's Bower, *Clematis Virginiana*, L.
Liver-leaf, *Hepatica triloba*, Chaix.
Early Meadow-Rue, *Thalictrum dioicum*, L.
Purplish Meadow-Rue, *T. purpurascens*, L.
White Water-Crowfoot, *Ranunculus aquatilis var. trichophyllus*, Gray.
Small-flowered Crowfoot, *Ranunculus abortivus*, L.
Hooked Crowfoot, *R. recurvatus*, Poir.
Hooked Crowfoot, *R. septentrionalis*, Poir.
Hooked Crowfoot, *R. Macounii*, Britton.
Tall Crowfoot or Buttercup, *R. acris*, L.
Marsh Marigold or Cowslips, *Caltha palustris*, L.
Goldthread, *Coptis trifolia*, Salisb.
Wild Columbine, *Aquilegia Canadensis*, L.
Red Baneberry, *Actaea spicata var. rubra*, Ait.
White Baneberry, *A. alba*, Bigelow.
Pappoose-root, *Caulophyllum thalictroides*, Michx.
Moonseed, *Menispermum Canadense*, L.
Blood-root, *Sanguinaria Canadensis*, L.
Dutchman's Breeches, *Dicentra cucullaria*, D. C.
Squirrel Corn, *D. Canadensis*, D. C.
Pepper-root, Crinkle-root, *Dentaria diphylla*, L.
Land Cress, *Cardamine Pennsylvanica*, Muhl.
Land Cress, *C. parviflora*, L.
Marsh Cress, *Nasturtium terrestre*, R. Br.
Worm-seed Mustard, *Erysimum cheiranthoides*, L.
Hedge Mustard, *Sisymbrium officinale*, Scop.
Tumbling Mustard, *S. altissumum*, L.
English Charlock, *Brassica Sinapistrum*, Boiss.
Shepherd's Purse, *Capsella Bursa-pastoris*, Moench.
Wild Peppergrass, *Lepidium apetalum*, Willd.
Field Cress, *L. campestre*, R. Br.
False Miter-Wort, *Tiarella cordifolia*, L.
Bishop's Cap, *Mitella nuda*, L.
Golden Saxifrage, *Chrysosplenium Americanum*, Schwein.
Gooseberry, *Ribes synosbati*, L.
Gooseberry, *R. lacustre*, Poir.
Fetid currant, *R. prostratum*, L'Her.
Wild Black Currant, *R. floridum*, L'Her.
Red Currant, *Ribes rubrum var. subglandulosum*, Maxim.
Choke-Cherry, *Prunus Virginiana*, L.
Wild Black Cherry, *P. serotina*, Ehrh.
Nina bark, *Physocarpus opulifolius*, Maxim.
Dwarf Raspberry, *Rubus triflorus*, Richard.
Wild Raspberry, *R. strigosus*, Michx.
Blackberry, *R. Canadensis*, L.
Avens, *Geum album*, Gmelin.
Water or Purple Avens, *G. rivale*, L.
Strawberry, *Fragaria Americana* (Porter) Britt.
Norway Cinquefoil, *Potentilla Norvegica*, L.
American Mountain Ash, *Pyrus Americana*, D. C.
Ash-leaved Mountain Ash, *P. sambucifolia*, C. and S.
Scarlet Hawthorn, *Crataegus coccinea*, L.
Pear-thorn, *C. tomentosa*, L.
Service-berry, *Amelanchier Canadensis*, Torr. and Gray.
Red Clover, *Trifolium pratense*, L.
White Clover, *T. repens*, L.
Alsike Clover, *T. hybridum*, L.
Common Vetch, *Vicia sativa*, L.

Carolina Crane's-bill, *Geranium Carolinianum*, L.
Common Wood Sorrel, *Oxalis, Acetosella*, L.
Thyme-leaved Spurge, *Euphorbia serpyllifolia*, Pers.
Water Starwort, *Callitriche autumnalis*, L.
Mountain Maple, *Acer spicatum*, Lam.
Sugar Maple, *A. saccharinum*, Wang.
Red or Swamp Maple, *A. rubrum*, L.
Spotted Touch-me-not, *Impatiens fulva*, Nutt.
Buckthorn, *Rhamnus alnifolia*, L'Her.
Basswood, *Tilia Americana*, L.
Common Blue Violet, *Viola cucullata*, Ait.
Sweet White Violet, *V. blanda*, Willd.
White Violet, *V. blanda var. palustriformis*, Gray.
Kidney-leaved Violet, *V. renifolia*, A. Gray.
Yellow Violet, *V. scabrinscula*, (T. & G.) Schwein.
Canada Violet, *V. Canadensis*, L.
Muhlenberg's Violet, *V. canina var. Muhlenbergii*, Gray.
Violet, *V.*, new species.
Moosewood, *Dirca palustris*, L.
Great Willow-herb, *Epilobium spicatum*, Lam.
Great Willow-herb, *E. adenocaulon*, Haussk.
Common Evening Primrose, *Oenothera biennis*, L.
Smaller Enchanter's Nightshade, *Circaea alpina*, L.
Spikenard, *Aralia racemosa*, L.
Wild Sarsaparilla, *A. nudicaulis*, L.
Cow Parsnip, *Heracleum lanatum*, Michx.
Water Parsnip, *Sium cicutaefolium*, Gmelin.
Sweet Cicely, *Osmorrhiza brevistylis*, D. C.
Sanicle, *Sanicula Marylandica*, L.
Bunch-berry, *Cornus Canadensis*, L.
Dogwood, *C. alternifolia*, L. f.
Red-Osier, *C. stolonifera*, Michx.
Skin-leaf, *Pyrola secunda*, L.
Blue-berry, *Vaccinium Canadense*, Kalm.
Trailing Arbutus, *Epigaea repens*, L.
Star-flower, *Trientalis Americana*, Pursh.
Black Ash, *Fraxinus sambucifolia*, Lam.
Spreading Dogbane, *Apocynum androsaemifolium*, L.
Common Hound's Tongue, *Cynoglossum officinale*, L.
Stickseed, *Echinosperum Lappula*, Lehm.
Blue Vervain, *Verbena hastata*, L.
Wild Mint, *Mentha Canadensis*, L.
Bugle-weed, *Lycopus Virginicus*, L.
Bugle-weed, *L. sinuatus*, Ell.
Mad-dog Skullcap, *Scutellaria lateriflora*, L.
Mad-dog Skullcap, *S. galericulata*, L.
Heal-All, *Brunella vulgaris*, L.
Common Hemp-Nettle, *Galeopsis Tetrahit*, L.
Basil, *Calamintha clinopodium*, Benth,
Figwort, *Scrophularia nodosa var. Marilandica*, Gray.
Monkey Flower, *Mimulus ringens*, L.
False Pimpernel, *Ilysanthes riparia*, Raf.
American Brooklime, *Veronica Americana*, Schwein.
American Brookline, *Chelone glabra*, L.
Common Plantain, *Plantago major*, L.
Patridge Berry, *Mitchella repens*, L.
Small Bedstraw, *Galium trifidum pusillum*, Gray.
Rough Bedstraw, *G. asprellum*, Michx.
Sweet-scented Bedstraw, *G. triflorum*, Michx.
Red-berried Elder, *Sambucus racemosa*, L.
Cranberry Tree, *Viburnum Opulus*, L.
Horse-Gentian, *Triosteum perfoliatum*, L.
Twin-flower, *Linnaea borealis*, Gronov.
Fly-Honeysuckle, *Lonicera ciliata*, Muhl.

Bush-Honeysuckle, *Diervilla trifida*, Moench.
Joe-Pye Weed, *Eupatorium purpureum*, L.
Thoroughwort, *E. perfoliatum*, L.
White Snake-root, *E. ageratoides*, L.
Golden-rod, *Solidago uliginosa*, Nutt.
Golden-rod, *S. Canadensis*, L.
Golden-rod, *S. serotina*, Ait.
Aster, *Aster macrophyllus*, L.
Aster, *A. puniceus*, L.
Aster, *A. diffusus*, Ait.
Aster, *A. paniculatus*, Lam.
Fleabane, *Erigeron Canadensis*, L.
Pearly Everlasting, *Anaphalis margaritacea*, B. and H.
Common Everlasting, *Gnaphalium polycephalum*, Michx.
Common Everlasting, *G. decurrens*, Ives.
Swamp Beggar-ticks, *Bidens connata*, Muhl.
Smaller Bur-Marigold, *B. cernua*, L.
Larger Bur-Marigold, *B. chrysanthemoides*, Michx.
May-weed, *Anthemis Cotula*, D. C.
Yarrow, *Achillea Millifolium*, L.
Ox-eye or White Daisy, *Chrysanthemum Leucanthemum*, L.
Wormwood, *Artemisia biennis*, Willd.
Life-root, *Senecio Balsamitae*, Torr. and Gray.
Fireweed, *Erechtites hieracifolia*, Raf.
Common or Bull Thistle, *Cnicus lanceolatus*, Hoffm.
Swamp Thistle, *C. muticus*, Pursh.
Canada Thistle, *C. arvensis*, Hoffm.
White Lettuce, *Prenanthes alba*, L.
Common Dandelion, *Taraxacum officinale*, Weber.
Wild Lettuce, *Lactuca Canadensis*, L.
Wild Lettuce, *L. leucophaea*, Gray.
Spiny-leaved Sow-Thistle, *Sonchus asper*, Vill.

LIST OF INTRODUCED WEEDS.

Tall Buttercups, *Ranunculus acris.*
Hedge Mustard, *Sisymbrium officinale.*
Tumbling Mustard, *S. altissimum.*
Charlock, *Brassica Sinapistrum.*
Shepherd's Purse, *Capsella Bursa-pastoris.*
Field Cress, *Lepidium campestre.*
Night-flowering Catchfly, *Silene noctiflora.*
Mouse-ear Chickweed, *Cerastium vulgatum.*
Common Purslane, *Portulaca oleracea.*
May-weed, *Anthemis Cotula.*
Ox-eye Daisy, *Chrysanthemum Leucanthemum.*
Canada Thistle, *Cnicus arvensis.*
Bull Thistle, *C. lanceolatus.*
Common Dandelion, *Taraxicum officinale.*
Spiny-leaved Sow-Thistle, *Sonchus asper.*
Stick-seed, *Echinospermum Lappula.*
Common Hound's Tongue, *Cynoglossum officinale.*
Common Hemp-Nettle, *Galeopsis Tetrahit.*
Pigweed, *Amarantus retroflexus.*
Lamb's Quarters, *Chenopodium album.*
Narrow-leaved Dock, *Rumex crispus.*
Bitter Dock, *R. obtusifolius.*
Lady's Thumb, *Polygonum Persicaria.*
Quack Grass, *Agropyron repens.*
Goose Grass, *Polygonum aviculare.*

LIST OF WEEDS INTRODUCED IN PACKING MATERIAL FROM PAINESVILLE, OHIO, IN 1900.

Rugel's Plantain, *Plantago Rugelii.*
Slender Rush, *Juncus tenuis.*
Witch Grass, *Panicum capillare.*
Barnyard Grass, *P. crus-galli.*
Finger-grass, *P. sanguinale.*
Sheep Sorrel, *Rumex acetosella.*
Pigeon Grass, *Setaria viridis.*
Pigeon Grass, *S. glauca.*
Stink-Grass, *Eragrostis major.*
Stink-Grass, *E. Purshii.*
Bull Thistle, *Cnicus lanceolatus.*
Sow-Thistle, *Sonchus oleraceus.*
Pigweed, *Amarantus retroflexus.*
Michaux's Cyperus, *Cyperus speciosus.*

DISEASES NOTICED ON CULTIVATED PLANTS.

The following is a list of fungi causing plant diseases which were collected on the station grounds, specimens of which have been placed in the Herbarium:

Early blight on potatoes.

Rusts were plentiful on wheat, oats, rye and barley.

(The fact that the seed grains were brought from a distance and that no crops of barley, wheat or rye were grown in the immediate neighborhood, tends to strengthen the theory that rust may exist in the seed.)

Leaf spot on strawberries.
Rust on corn.
Shot-hole fungus on plums and cherries.
Mildew on gooseberries.
Spot disease of gooseberry.
Alternaria on turnips.
Leaf spot on sugar beets.

"Sun scald" injured some of the young shoots of newly set apples in August, but the trees had recovered by September first.

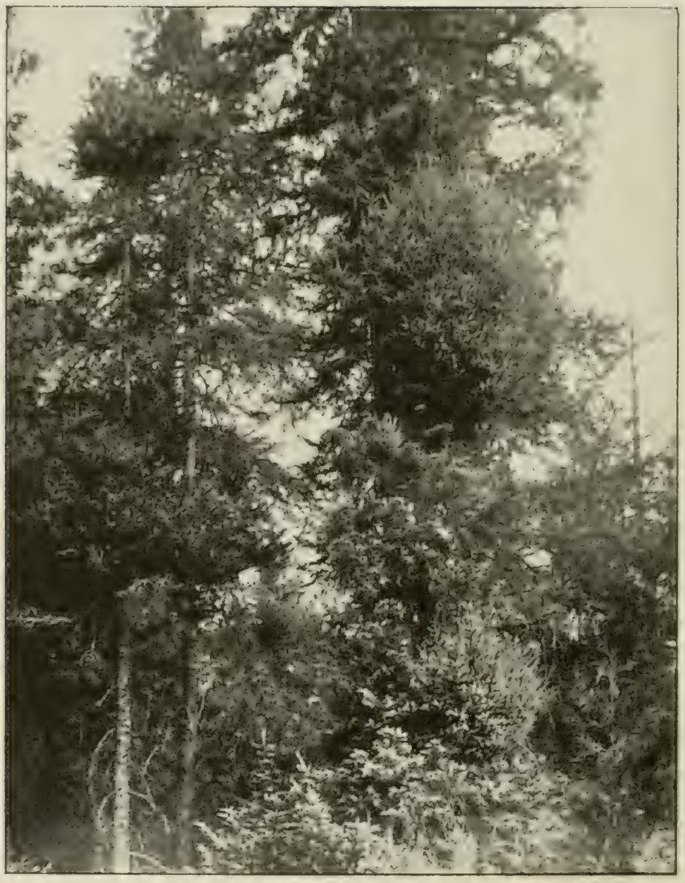
The following plants are reported from the Upper Peninsula for the first time, all found in the station woods:

Aspidium Goldianum.
Asplenium augustifolium.
Carex careyana.
Carex sychnocephala.
Triosteum perfoliatum.
A violet was found in fruit, which is probably unnamed.

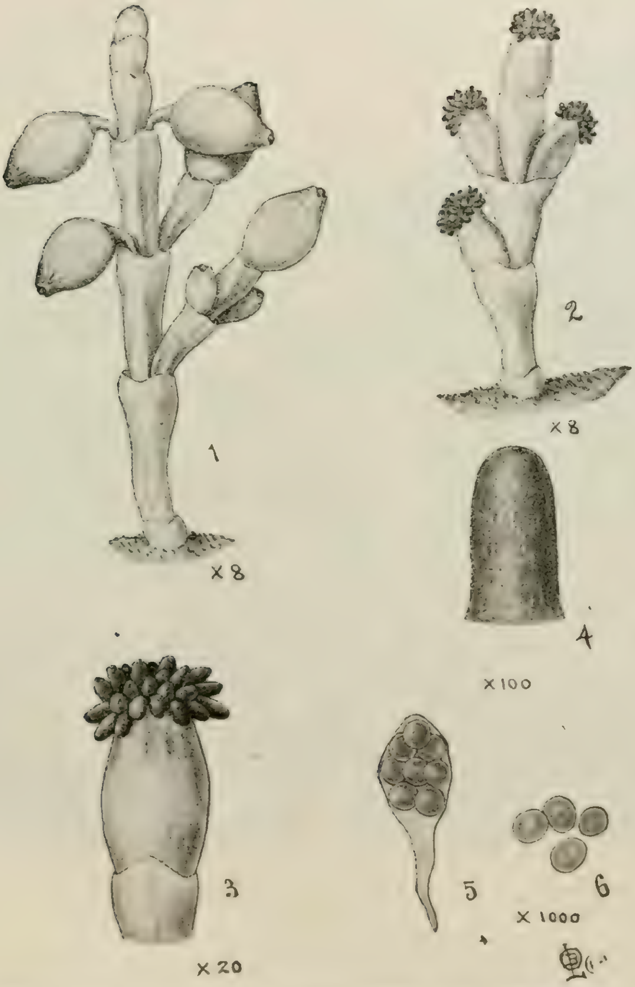
THE DWARF MISTLETOE IN MICHIGAN.

One plant new to the State was found, which deserves notice from the fact that it is a parasite on the black spruce. This plant is the dwarf mistletoe (*Arceuthobium pusillum*, Peck). This mistletoe was found August 30 in a tamarack swamp, a fourth of a mile north of the station. The plant is only an inch high, but makes up in numbers what it lacks in size. The male and female plants are usually found on different trees. They stand thickly on the upper sides of the branches. The female plants first appear on two-year-old branches, and the fruiting plants do not perfect their seeds until they are two years old, so they are plentiful on four-year-old branches, and some were seen on even older branches; in one case the affected branch was twelve years old. The male plants first appear on three-year-old wood. The seeds ripen early in September, being covered with a sticky substance and being expelled with considerable force from the fruits, they stick to the branches, where they germinate and enter the host tree. The effect on the tree is remarkable. When a tree is attacked by this parasite, the branch affected is stimulated to an extra growth, forming dense clusters of spindling branches, which take an upright growth, forming large bunches on the trees, which are readily noticed. These clusters have the

Healthy Black Spruces.



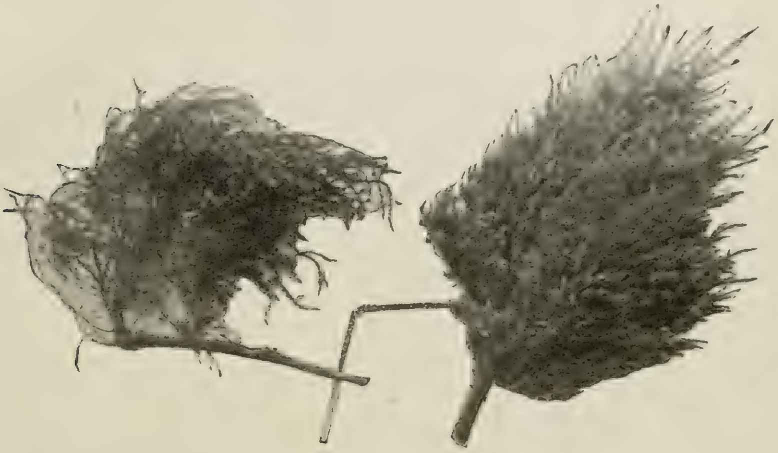
Black Spruces attacked by the Dwarf Mistletoe or "Witch's Broom."



The Dwarf Mistletoe (Arceuthobium pusillum, Peck), attacked by the fungus (Wallrothiella arceuthobii, Peck). 1—The Mistletoe free from the fungus. 2—Mistletoe attacked by fungus. 3—A single fruit of the Mistletoe enlarged, showing the disease. 4.—A single fruit of the fungus enlarged. 5—A sporecase showing cluster of eight spores. 6—A group of spores highly magnified.

An excellent edible Mushroom.

common name of witch's brooms, Hexenbesen, the Germans call them. These witch's brooms continue to increase in size, and when a number of branches are diseased, the tree finally dies as a result of the attack. This parasite is widely distributed in the Upper Peninsula. I saw it in nearly every swamp from Chatham to Soo Junction, a distance of one hundred miles. In some of these swamps nearly every tree had been killed.



Diseased branches of the Black Spruce.

The damage done by the mistletoe is considerable, but just how great cannot be determined without farther examination. While examining the plants in the office, I found that the mistletoe was also attacked by a fungus parasite, which must have a tendency to check the spread of this pest. Each fruit is attacked at its apex by the fungus *Wallrothiella arceuthobii*, Peck, and. of course, destroyed. This mistletoe was first found by Mrs. L. A. Millington, a former resident of Michigan, at Warrensburg, New York. It was discovered the same year by C. H. Peck, state botanist of New York, who also found the fungus, and who gave both parasites their names. The cuts on earlier pages give a good notion of healthy and diseased spruce trees.

C. F. WHEELER,
Botanist of Experiment Station.

Agricultural College, Nov. 1, 1900.

INSECT AND ANIMAL LIFE ON THE UPPER PENINSULA EXPERIMENT STATION.

R. H. PETTIT, ENTOMOLOGIST.

INTRODUCTION.

During the latter part of August the writer, in company with Professor Wheeler, visited the State Sub-station at Chatham, remaining there about twelve days. Afterward a visit was made to Beaver Island, in Lake Michigan. During all the time the object of the writer was to obtain specimens of as many forms of animal life as possible, with special reference to economic species. The following brief report deals mainly with the life at Chatham, although the list of shells and spiders includes those at Beaver Island as well.

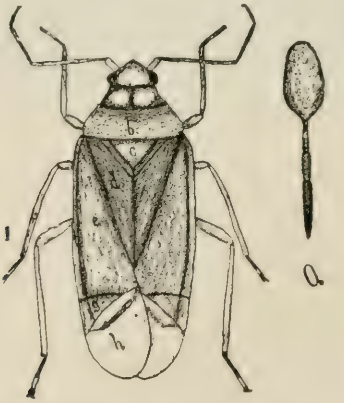
The time of the year was not an ideal one for collecting, although for economic work it was perhaps as good as any. Considerable time was consumed in preparing specimens, both vertebrate and insect, and in taking photographs; and, of the material collected, it is at present impossible to include a considerable part, as a number of the insects are still in the breeding cages, and very many more will have to be sent to specialists for identification.

The writer wishes to extend his thanks to Dr. Bryant Walker, of Detroit, who has kindly determined the molluscs; to Mr. Nathan Banks, of the Division of Entomology at Washington, who did the same for the spider, the Neuroptera and the Trichoptera; to Professor W. S. Blatchley, State Geologist of Indiana, for determining one of the grasshoppers, credit for which is given in the text: to Mr. Matt Crosby for the privilege of examining his collection, made at Chatham during the past season, insects listed from his collection being marked with his name; and to Mr. Leo Geismar for aid and kindness shown in many ways.

TREE-HOPPERS AND LEAF-BUGS.

(*Jassidae and Capsidae.*)

Many species of small tree-hoppers, leaf-bugs and other sucking insects were found in the regions visited. It will not be necessary to go into exact details in discussing them, since the same general remedies serve against almost all of them. They are very small insects, usually elongated and often green or pale in color, though some of



Hollyhock bug (*Orthotylus delicatus*), from Cook and Davis, Bull. 76 Mich. Exp. Station.

them are brightly colored. The feeding habits of the different kinds of insects in this class are very much alike, except that each species usually is restricted to a limited number of food-plants. They are provided with sharp, sucking beaks, which extract the sap and juices from trees and plants of all sorts. Some of them work on grasses. The effect is the gradual decline of the plant attacked. If the plant is of any size, this injury may go on and stop at any point, depending on the amount of food extracted and the damage due to the wounds of the beaks. Unless the insects are seen to be present, the exact cause of the injury is often difficult to locate, as the punctures are very small and the wounds are not conspicuous.

Many of these small sucking insects are to be found in the Upper Peninsula as well as in the Lower, and in spite of the fact that vegetation is vigorous, the tax levied by these apparently insignificant insects is quite a heavy one. The remedy is the same for all—spraying with a strong tobacco extract when they are seen to be at work, and the destruction of rubbish in the winter time.

While probably they never can be exterminated by the methods advised, beneficial results certainly will follow the practice if it is conscientiously carried out from year to year. Insects of this class, most of them, pass the winter in rubbish and in out of the way places. Now, the destruction of all rubbish after the cold weather has once set in will do away with great numbers of the insects. This is especially true in towns and in regions not wooded. In new clearings many of the insects will resort to the woods for shelter, and of course cannot be reached, but the general practice of clean culture will prove of noticeable and lasting benefit.

THE CANOE-BIRCH COCCID.

(*Xylococcus betulæ*, Hub. & Pergande.)

This interesting scale-insect was found at Munising and at Harbor Springs. It was first found by Messrs. Hubbard and Schwarz at Michipicoten and near Marquette, both on Lake Superior. The insect works in the bark of canoe-birch, making cavities in the bark and splitting the layers so that it becomes useless for the purpose of canoe making. Mr. Hubbard says:* "In 1876, when Mr. Schwarz and I visited the north shore of the lake at Michipicoten river, we were told that the Indians were obliged to go sixty miles back into the interior in order to find sheets of bark of sufficient size for the construction of canoes." The first indication of its presence that attracts the eye is the roughened surface of the bark, especially near the ground. On closer examination, it is possible to find very delicate, glassy filaments projecting from cavities in the bark. These are waxy in nature and protrude from about the caudal extremity of the coccid. Very little time was available to search for these interesting insects, but they were seen to be quite plentiful at Pictured Rocks, on a few isolated trees.

FALL ARMY-WORM.

(*Laphygma frugiperda*, S. & A.)

A curious change of habit, which, it is hoped, will not prove more than temporary, was observed in this species. Ordinarily the fall army-worm works like a fall cutworm, feeding on many different crops and on some uncultivated plants. This year, however, it attacked the corn crop in large numbers, entering the ear and burrowing into the kernels both when they were in the milk and later, just as is done by the regular corn-worm (*Heliothus armiger*). The corn at the Station grounds was badly affected. Specimens were obtained for rearing purposes and placed in cages in the laboratory. From this material a single moth emerged on October 25, the larvæ having been received fresh from Mr. Geismar on September 10. This moth, together with a pair of larvæ, was sent to Professor J. B. Smith, of the New Jersey Experiment Station, who kindly determined it for me as *Laphygma frugiperda*.

REMEDIES.

In regard to remedial measures, Dr. J. B. Smith says:† "There are always two and sometimes three or more broods in the course of the year, and in favorable seasons these become successively more numerous, so that the late fall brood proves the most troublesome. These favorable seasons, however, do not often occur, particularly in the Eastern United States, and here climatic influences or other natural conditions reach the insects during the winter, so that in the spring following only a normal number survive. Cultivating the land in crops which admit of fall plowing is best adapted to avoid injury, and a frequent rotation will prevent them from becoming numerous enough to be destructive at any time."

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*Bulletin 18, New Series, Dept. of Agriculture, Division of Entomology.

†Economic Entomology, p. 297.

THE WHITE-MARKED TUSSOCK-MOTH.

(*Notolophus leucostigma*, S. & A.)

Familiar objects to many of us are the larvæ of caterpillars of this insect, which are about one and one-half inches long, yellow and black striped longitudinally. The head, prothoracic shield and two spots on the backs of the sixth and seventh segments are bright sealing-wax red. From each side of the first segment behind the head projects a tuft of long black hairs, forming a V-shaped fork half an inch long, which points and opens forward. From the back of the eighth segment projects backward a single similar tuft of long hairs, and on the backs of each of the first four abdominal segments is a brush-like tuft of cream-colored short hairs. Beside these there are numerous yellow hairs on the sides of the body. These brightly colored caterpillars are not at all particular in regard to their food, almost any shade or fruit tree answering the purpose. They feed alike upon apple, pear, plum, cherry, maple, elm, poplar and a large number of other trees.

When full grown the larva spins a cocoon, usually upon the tree itself, partly protected by some roughness in the bark, or else nearby on adjacent objects, usually more or less exposed. The adults of this insect are notable because the sexes are very different. The males are very pretty moths or "millers," which are provided with wings and which fly with ease. The females, on the other hand, have no wings, but are quite large and swollen creatures, capable only of laying eggs. The female comes forth from the cocoon, awaits the coming of the male, and then lays her eggs upon the empty cocoon, in a frothy mass that dries down, forming a friable, spongy covering, pure white in color unless discolored by the elements. The winter is passed in this stage, and early in the spring the eggs hatch, each giving forth a young caterpillar.

There are two broods and possibly more South, but it is not possible now to say whether there are one or two broods in upper Michigan. On August 29, an adult female on a freshly laid mass of eggs was found at Au Train Falls.

The damage done to the shade trees in a city or park is sometimes very serious. Detroit has been for some time the scene of an attack: Like the canker-worm, when the insect appears it usually comes to stay, and vigorous measures are required to overcome it.

REMEDIES.

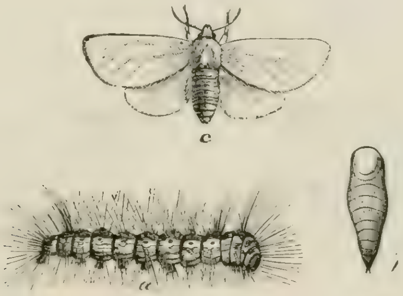
The amount of labor and money that it will be found expedient to use in a given case will depend largely upon the circumstances. In cities it will be found possible to do much more than in hamlets or villages, while in isolated farms still less will be thought profitable, except in cases where orchards are infested. The eggs being laid in masses, sometimes 500 of them in a single bunch, and these masses being conspicuous and not well hidden, it will be found profitable to collect all egg-masses on the old cocoons during the winter season, that is, late in the fall and early in spring, or whenever they are accessible. This has been done cheaply by school children in cities for a small remuneration. The caterpillars can be killed by a thorough spray of paris green, but tall shade trees are very difficult to treat in this way. The usual way of overcoming this difficulty is to build a tall stage on a wagon and to spray from this stage, using long bamboo rods with a nozzle at one end and connected at the other end with the hose. Another method which is preventive is to band such trees as are not infested, with a strip of cotton batting. The eggs being laid on the old cocoon, fresh trees will be infested by caterpillars crawling to them, and in no other way. A band of loose cotton batting, renewed from time to time as it loses its fluffiness from rain, will entangle the larvæ as they try to climb into the tree.

THE FALL WEB-WORM.

(*Hyphantria cunca*, Dru.)

Early in autumn or late in summer the large nests or webs of this caterpillar are seen in the branches of many fruit and shade trees.

Unlike the apple-tree tent-caterpillars, which work in our apple trees in the springtime, the larvæ of this species build a web as far as they work. Both live in colonies, but the spring tent-caterpillar builds a small tent, from which the larvæ go out to feed and to which they return. The fall web-worm, on the other hand, extends the nest as it becomes necessary in order to accommodate the growth of the colony. The colony is the result of a cluster of eggs laid by a single moth, usually on a leaf.



Fall web-worm (*Hyphantria cunca*), from C. V. Riley, insects of Missouri, 3d Rep.

The caterpillars of this insect are hairy fellows, a little less than two inches in length. There is one brood a year in the North, though further South it is said that there are more. The caterpillars are light in color, yellowish, with a darker stripe on the back. When full grown they are covered with long whitish hairs. It has been said that the web is extended as the size of the colony increases. This goes on until the larvæ are very nearly full grown, when they leave the shelter and seek convenient retreats for spinning up in cocoons. This is done in almost any sheltered place, under bark or rubbish, or under the surface of the soil. The moth that comes from the cocoon measures about one and one-fourth inches from tip to tip of its extended wings. It is usually pure white, though many specimens have dark spots on the wings. The insect feeds on one hundred and twenty species of shrubs and ornamental trees,* and the damage done is often very serious. Specimens were collected on wild cherry at Chatham on August 28, 1900. A specimen of the female moth and an egg-cluster just laid were sent by Mr. Geismar on July 12.

REMEDIES.

The cocoons may be collected in the winter time whenever that is feasible. Spraying the affected trees with one of the arsenites is another remedy that is often found useful. The best remedy, however, after the larvæ have obtained a start, is to apply a torch to the nest and burn them out. A bundle of oil-soaked rags or sponges tied to a long pole, or a porous brick attached in the same way, answers the purpose perfectly. With this the nest may be entirely demolished and the occupants singed without doing more than slight damage to the tree, if care is taken to move the torch quickly. Of course, the earlier this is done the better.

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*Dr. L. O. Howard, Year-book, Dept. of Agr. for 1895, p. 376.

CABBAGE-WORMS.

(*Pieris oleracea, Pieris rapæ,* and *Pontia protodice.*)

All three of the cabbage butterflies were present at Chatham. We have in this country three different species or kinds of cabbage butterflies; two are native and one is introduced from Europe. Of the native species, one *Pieris oleracea, is* pure white, the spring brood having the veins marked with grey scales on the under side of the wings. This is the native form originally found in the northern part of the United States. The larva feeds on a variety of plants, though it takes quite readily to cabbage. The species is now comparatively rare in most places, though quite common at Chatham.

The southern native species (*Pontia protodice*) is white, with a number of black checkered marks on the wings, the female having much more of the black than the male. The larva of this butterfly feeds on cabbage, rape, and a number of other plants.

(*Pieris oleracea, Pieris rapæ,* and *Pontia protodice.*)

The worst of all three, however, is the imported cabbage-butterfly (*Pieris rapæ*). This is white, with the tips of the front wings black. The female has two black spots on the front wings; in the male there is only one. Of all the butterflies that are injurious to crops in America this is undoubtedly the worst. The larvæ work in cabbage, rape, rutabagas and various other plants. From the nature of the case, poison cannot safely be used, and we have to resort to other means for destroying them. One of these is hot water. This has proven successful in certain cases, though complaints have come from some parties who have used it. The efficacy of hot water depends upon the fact that it takes a less degree of heat to kill cabbage-worms than it does to injure the cabbage.

The ordinary manner of applying the hot water is through a sprinkler. Water is taken, boiling hot, to the field and poured into a sprinkler. From this it is poured on the infested plants, killing the worms, but not injuring the cabbages. Now the exact distance that must be maintained between the watering-pot and the plants cannot be stated, because the watering pots vary so much as to the size of the holes, and the temperature is likely to vary with the distance from the heating apparatus. The finer the holes, of course, the nearer one can get to the plants. If, on the other hand, the holes in the sprinkler are coarse, the drops of water will not cool sufficiently and the plants will be injured. Everyone must try for himself on a few plants at first, and then wait to see the effect.

Another remedy that is on some accounts better is kerosene emulsion applied in the ordinary way. Professor Hillman, of the Nevada Experiment Station, highly recommends the addition of one ounce of Pyrethrum or Persian insect-powder to the liquid when it is ready to apply. The writer has tried an emulsion of the kerosene extract of Pyrethrum, which amounts to the same thing, and found it very effective against many resistant insects.

The work against the early broods of these insects in spring and early summer should be prosecuted with great vigor. At this time, before the head begins to form, the most effective work can be done.

MOSQUITOES.

(*Culex pungens*, Wied.)

During the latter part of August, at the time when the writer was at the Sub-Station, mosquitoes were not very abundant. It is said that earlier in the season they are more numerous. Land that is being cleared furnishes an ideal place for them to breed. Holes made by removing stumps and into which water has settled are often fairly alive with the wrigglers. The writer collected a large number of the larvæ and pupæ from a hole which would hold little more than a pailfull of water, and bred the adults from them. They proved to be *Culex pungens* in this case. No other species were collected. No specimens of *Anopheles*, the malaria transmitting genus were seen, although especial care was taken to look for them.

The control of mosquitoes in such places is so easily maintained that it seems a pity that nothing is attempted in this direction. Dr. L. O. Howard has pointed out, time and again, that a few teaspoonfuls of kerosene will kill all the immature mosquitoes or wrigglers in a small pool, as well as many of the adults when they come to lay their eggs. In swampy places this method is more difficult to carry out, but in good, high ground, with swift water, such as is so common here, there are so few pools of any size that almost all of them could easily be treated twice a month, and the mosquito nuisance materially abated thereby. Everyone is familiar with the way that oil spreads over water, and it needs but a moment's consideration to see how kerosene, so deadly to all insect life, will kill any aquatic insects as they come to the surface to breathe. Dr. Howard recommends an ounce of the oil to fifteen square feet of water surface, and he says that the treatment need not be repeated for a month.

NO-SEE-UM.

(*Ceratopogon sp.*)

Specimens of no-see-um were collected, although they were almost entirely gone by the latter end of August. They proved to be *Ceratopogon* and very closely related to, if not identical with, the "Punkie" of the Adirondacks. This insect is a very minute fly that bites.

THE POTATO-BEETLE TACHINID.

(*Phorocera doryphoræ*, Riley.)

Potato Beetle with eggs of Tachina Fly (*Phorocera doryphoræ*), original.

As early as 1869 this fly was found to be parasitic in potato-beetles. Dr. Riley described the fly, in his first report, under the name of *Lydella doryphoræ*.*

This beneficial insect is a fly somewhat resembling a house-fly, except that the back of the abdomen has silvery spots on it and that the face is silvery white. In size it is a very little larger than the house-fly. This fly lays its eggs on the bodies of potato-beetle larvæ as well as on the adults. The egg laid on the larva hatches out

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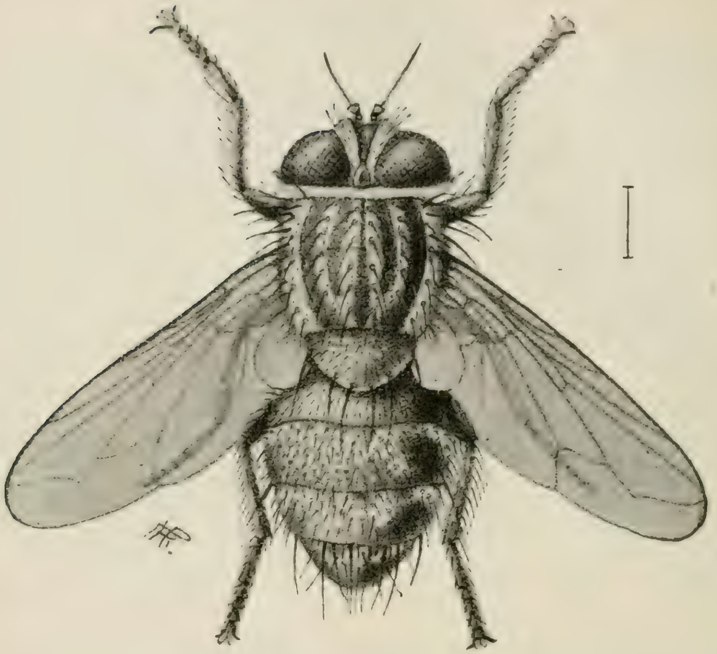
*Riley 1st Rep. Insects of Mo., p. 111. 1869.



Potato-beetle parasite (Phorocera doryphorae), original.

and a small grub bores into its host, feeding on the living flesh and the juices of the body, but avoiding the vital parts. After the maggot has become full grown in its living host, and after the larva of the beetle has descended into the ground to pupate, the maggot changes to a puparium, corresponding to the cocoon stage of some insects. From this puparium issues another fly similar to the one which originally laid the egg. This goes on a number of times in a season, each generation of the flies destroying a number of potato-bug larvæ.

Specimens of the potato-bug larvæ, with eggs of the fly on them, were sent the writer by Mr. Geismar, and were placed in suitable cages in order to watch the transformations. The larvæ went into the ground just as they should, but only one fly has, as yet, come forth. It is possible that more will emerge next spring. The process of depositing the egg is described in a letter by Mr. Geismar, who says: "I noticed a fly walking around a beetle in a peculiar way, touching it from time to time. As soon as the beetle appeared dormant the fly commenced to lay its eggs on top of the beetle, always keeping its head toward it and circling around it once or twice. The fly, to lay its egg in that position, passes the appendage under its body and head and raising it somewhat above its head drops an egg on the top of the beetle."

A number of adult beetles, each bearing from one to sixteen eggs, were placed in a cage with food, in hopes that the larvæ might work on them. These beetles lived from July 12 until August 21, at which time the writer went away and no more observations were taken. No signs of attack, however, by the parasites were to be seen. Most of the eggs dropped off one at a time.

An attempt was made to introduce the flies here, in order to get them to work on our potato-beetles, but as no fresh flies emerged, it was impossible. A little later in the season four flies, which the writer is unable to distinguish from the potato-beetle parasite, were bred from cut-worms. The cut-worms were the last two of a large number of rapidly disappearing depredators in a field of oats and peas. They cut the oat stems into sections several inches long and also cut the pea vines. The larvæ were brought in on August 1 and the flies emerged on August 8. This would seem to indicate that the parasite in question has more than one host.

The writer was asked several times during his stay in Alger county why it was that the potato-beetles were so few in that region during the summer just passed. It is not at all unlikely their attacks were materially reduced by this parasite.

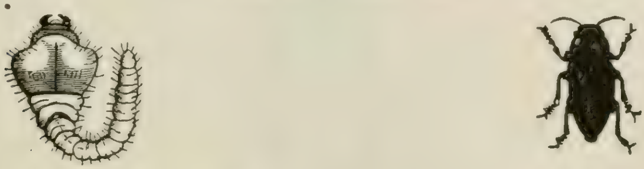
WHEAT-HEAD FLY.

(*Meromyza americana*, Fitch.)

Specimens of rye, having the heads bleached out to a dry, straw-color, while the leaves and stem below the upper joint were apparently healthy, were sent by Mr. Geismar on July 10. They were placed in a cage, and on August 2, the adults emerged. The larva of this fly works just above the top joint in rye, wheat and some grasses, eating out the succulent base of the stem at this point. The only remedial measure yet known is the rotation of crops.

THE FLAT-HEADED APPLE-TREE BORER.

(*Chrysobothris femorata*, Fab.)



Flat-headed Apple-tree Borer (*Chrysobothris femorata*), from C. V. Riley, Insects of Missouri, 2d Rep.

This insect bores into the trunks and larger limbs of apple trees, doing very great damage. It is the worst borer of the apple, while it works also in oak, peach, soft maple, weeping willow, mountain ash, box-elder, pear, linden, beech and cherry.

The eggs are said to be laid on the bark in June and during the fore part of July. The larvæ work at first in the sap-wood, making cavities between the bark and the wood, ejecting their excrement through small openings in the bark. Late in the summer or early in the fall they penetrate into the solid heart-wood to pass the winter, ceasing at this time to eject castings, instead, packing their waste in the cavities just vacated. It takes two or three years for them to become perfect, winged insects. The larva that does all this damage is white and soft, unprotected otherwise than by its habitation. The front end of the body, or the thorax, is very broad and oval and the head small. The holes bored by this insect are not round, but oval in section, fitting the form of the thorax.

REMEDIES.

Now, borers are difficult things to fight under all circumstances, and no course of treatment is known which will entirely eradicate them. Nevertheless, every one that is killed is just so much gained for the general good. There are three practices that have been found useful, though no one of them or all of them combined will rid an orchard of an insect that breeds in so many host trees. They are the same old remedies recommended by Dr. Fitch many years ago and which have not since been improved upon.

They consist in protecting by means of a wash, binding the trunk with paper, and digging out the young larvæ.

Whitewash or whitewash and glue, applied to the trunk and large limbs is said to have a very beneficial effect. It should be applied early in June, and kept on in good condition through most of July. Soft soap is also used for this purpose.

Second, binding paper about the trunk and larger limbs. For this purpose newspaper is best used next the tree and building paper outside.

Third, searching for the young larvæ during August and September. At this time the young have not gone into the sap-wood, but live in cavities just under the bark, the excrement being pushed out through small holes. When any suspicious waste is seen protruding from the bark, it is well to investigate with a stiff pin, and if a cavity is found, to extract the occupant before he goes so deeply into the wood as to be beyond our reach. A little time spent each fall in this way will be well repaid by increased vigor of our orchards.

THE CHERRY LEAF-BEETLE.

(*Galerucella cavicollis*, Lec.)

The cherry leaf-beetle is an interesting species, because of its known change of habit. It ordinarily feeds on pin cherry and was found in numbers on that host-plant at Au Train Falls. At least twice it has attacked the cultivated cherry in Michigan, each time doing appreciable injury. Mr. G. C. Davis mentions it in the Report of the Michigan Board of Agriculture for 1894, as occurring at Bellaire, and the writer has noticed it once in bulletin 160, as being injurious in 1897. At that time it was at Traverse City on June 8. The beetle readily responds to a spray of paris green whenever it becomes troublesome.

Cherry Leaf-Beetle (*Galerucella cavicollis*), from author's Bulletin 160.

LIST OF MOLLUSCS DETERMINED BY MR. BRYANT WALKER.

Limax campestris, *Say.*, Munising.
Vitrea rhodesi, *Pils.*, Munising Junction.
Vitrea indentata, *Say.*, Chatham.
Vertigo gouldii, *Binn.*, Munising Junction.
Conulus fulvus, *Dr.*, Munising Junction.
Zonitoides arboreus, *Say.*, Munising Junction, Chatham.
Pryamidula alternata, *Say.*, Beaver Island, Munising Junction.
Pyramidula striatella, *Anth.*, Munising Junction, Chatham.
Polygera albolabris, *Say.*, Beaver Island, Au Train Falls.
Polygera albolabris *var.* maritima, *Pils.*, Chatham.
Polygera monodon, *Rack.*, Munising, Munising Junction, Beaver Island.
Strobilops virgo, *Pils.*, Munising Junction.
Limnea catascopium, *Say.*, Beaver Island.
Limnea humilis, *Say.*, Beaver Island.
Limnea lancelata, *Gld.*, (?) Beaver Island.
Limnea sayii, *Tap.*, Beaver Island.
Limnea gyrina, *Say.*, Chatham, Munising Junction, Beaver Island.
Limnea ancillaria, *Say.*, Beaver Island.
Limnea ancillaria *var.* lacustris, *Walk.*, Beaver Island.
Limnea integra, *Hald.*, Beaver Island, Au Train Falls, Chatham.
Planorbis trivolvus, *Say.*, Beaver Island.
Valvata tricarinata, *Say.*, Beaver Island.
Valvata tricarinata *var.* bicarinata, *Lea.*, Beaver Island.
Campeloma decisa, *Say.*, Beaver Island.
Campeloma integra, *Say.*, Beaver Island.

Amnicola limosa, *Say.*, Beaver Island.
Amnicola lustrica, *Pils.*, Beaver Island.
Goniabasis livescens, *Mkc.*, Beaver Island, Petoskey, Au Train Falls.
Unio luteolus, *Lam.*, Beaver Island.
Anodonta fragilis, *Lam.*, Beaver Island.
Anodonta footiana, *Lea.*, Beaver Island.
Sphaerium striatinum, *Lam.*, Beaver Island.
Pisidium virginicum, *Bgt.*, Beaver Island.
Pisidium compressum, *Prm.*, Beaver Island.
Pisidium scutellatum, *St.*, Beaver Island.
Pisidium sp., Beaver Island.

LIST OF ARACHNIDAE DETERMINED BY MR. NATHAN BANKS.

Epeira domiciliorum, *Htz.*, Chatham, August 23, 1900.
Amaurobius bennetti, *Blk.*, Chatham, September 1, Munising, August 27, September 3, Munising Junction.
Philaeus militaris, *Htz.*, Chatham, August 23.
Pardosa sp. (young) Chatham, August 23.
Epeira trifolium, *Htz.*, Chatham, August 25.
Epeira insularis, *Htz.*, Beaver Island, September 6.
Epeira trivitta, *Keys.*, Beaver Island, September 6 and 8.
Tetragnathus extensa, *Linn.*, Beaver Island, September 6.
Otiogolophus pictus, *Wood.*, Beaver Island, September 6.
Phalangium cinerium, *Wood.*, Beaver Island, September 6.
Liburnum dorsatum, *S.*, Beaver Island, September 8.
Phlegmacera cavicoleus, *Pack.*, Beaver Island, September 8.
Misumena rosea, *Keys.*, Beaver Island, September 8.

PARTIAL LIST OF INSECTS COLLECTED IN ALGER COUNTY.

Order Odonata:
  Aeschna verticalis, *Hag.*, Chatham, August 22, 1900.
  Diplax rubicundula, *Say.*, Chatham, August 28.
  Diplax vicina, *Hag.*, Munising Junction, September 3.
Order Euplexoptera:
  Labia minor, *Linn.*, Chatham, August 22.
Order Orthoptera:
  Dissosteira carolina, *Linn.*, Munising Junction, September 3.
  Camnula pellucida, *Scud.*, Chatham, August 27.
  *Circotettix verriculatus, *Kirby*, Chatham, August 22.
  Melanoplus femoratus, *Burm.*, Chatham, August 28.
  Melanoplus atlanis, *Riley*, Chatham, August 22.
  Tettix sp., (nymph), Chatham, August 28.
  Tettix granulatus, *Kirb.*, Chatham, July 12 and August 8 (Crosby).
  Ceuthophilus sp., Munising Junction, September 3.
  Scudderia curvicauda, *De G.*, Munising Junction, August 22 and 28.
  Xiphidium fasciatum, *De G.*, Munising, September 3.
  Gryllus luctuosus, *Serv.*, Au Train Falls, August 29.
  Nemobius fasciatus, *De G.*, Au Train Falls, August 29.
Order Hemiptera (Heteroptera):
  Notonecta undulata, *Say.*, Munising Junction, September 3.
  Salda. sp., Au Train Falls, August 29.
  Rhagovelia sp., Au Train Falls, August 29.
  Hygrotrechus sp., Chatham, August 28.
  Limnoporus sp., Chatham, August 28.
  Limnoporus sp., Munising Junction, September 3.
  Sinea spinapes, *H. Schaf.*, Chatham, September 3.
  Coriscus sp., Chatham, September 1.
  Aradus sp., Munising Junction, September 3.
  Acanthia lectularia, *Linn.*, Chatham, August 28.
  Poecilocapsus goniophorus, *Say.*, Chatham, August 22.

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*Determined by Prof. W. S. Blatchley.

Poecilocapsus lineatus, *Fab.*, Chatham, July 5 (Crosby).
Lygus pratensis, *Linn.*, Chatham, August 23.
Pediculis vestimenti, *Leach*, Chatham, September 1 (Crosby).
Order Hemiptera (Homoptera):
Aphrophora sp., Chatham, August 22.
Ceresa diceros, *Say.*, Chatham, August 22.
Ceresa sp., Chatham, August 22.
Schizoneura tesselata, *Fitch*, Munising, August 26.
Xylococcus betulæ, *Hub.* and *Pergande.*, Pictured Rocks, August 26.
Order Neuroptera:
Chrysopa rufilabris, *Burm.*, Beaver Island, September 5.
Chrysopa oculata, *Say.*, Chatham, August 23.
Polystoechotes punctatus, *Fab.*, Chatham, August 23.
Order Trichoptera:
Neuronia semifasciata, *Say.*, Chatham, August 23.
Oecetina incerta, *Walk.*, Chatham, August 23.
Triaenodes ignita, *Walk.*, Chatham, August 23.
Heliopsyche sp., (larva), Au Train Falls, August 29.
Platyphylax sp., Chatham, August 23.
Order Lepidoptera:
Incurvaria acerifoliella, *Fitch.*, Chatham, August 22.
Sesia sp., Chatham, August 23.
Microgonia limbaria, *Haw.*, (Nematocampa), Chatham, June 26.
Haematopis grataria, *Fabr.*, Chatham, August 24.
Ochyria designata, *Hbn.*, Chatham, August 23.
Oreta rosea, *Walk.*, Chatham (Crosby).
Plusia balluca, *Geyer*, Chatham, August 6 (Crosby).
Plusia sp., Chatham, August 4 (Crosby).
Feltia subgothica, *Steph.*, Munising, August 26.
Laphygma frugiperda, *S.* and *A.* (larva), Chatham, September 1.
Catocala relicta, *Walk.*, Chatham, August 28.
Catocala sp., Chatham, July 12 (Crosby).
Notolophus leucostigma, *S.* and *A.*, Au Train Falls, August 29.
Notolophus antiqua (larva), Chatham, June 22 (Geismar).
Hyphantria cunea, *Dru.*, Chatham, August 28.
Nemophila noctuella, *S. V.*, Munising, August 26.
Pontia protodice, *Boisd. Le C.*, Chatham, August 23.
Pieris oleracea, *Harr.*, Chatham, August 23.
Pieris rapae, *Linn.*, Chatham, August 23.
Eurymus erytheme, *Boisd.*, Chatham, September 3.
Eurymus philodice, *God.*, Chatham, September 1.
Heodes hypophleus, *Boisd.*, Chatham, August 22.
Anosia plexhippus, *Linn.*, Chatham, August 22.
Argynnis cybele, *Fabr.*, Chatham, August 22.
Brenthis myrina, *Cram.*, Chatham, August 22.
Vanessa huntera, *Fabr.*, Chatham, August 22.
Vanessa atalanta, *Linn.*, Chatham, August 23.
Aglais milberti, *God.*, Chatham, August 22, Au Train Falls, August 29.
Euvanessa antiopa, *Linn.*, Chatham, August 24.
Polygonia comma, *Harr.*, Chatham, August 28.
Polygonia prognae, *Cram.*, Chatham, August 23, and Munising Junction, September 3.
Order Diptera:
Pachyrrhina ferruginea, Chatham, August 22.
Pedicia albivitta, *Walk.*, Chatham, August 22.
Limnobia cinctipes, *Say.*, Chatham, August 22.
Culex pungens, *Wied.* (bred), Chatham, August 29.
Ceratopogon sp., Munising, August 26.
Cecidomyia strobiloides, *Walsh*, Munising, August 26.
Plecia heteroptera, *Say.*, Munising Junction, September 3.
Bibio sp., Chatham, August 28.
Tabanus sp., Munising, August 26.
Tabanus sp., Chatham, September 1.
Tabanus lasiopthalmus, *Macq.*, Chatham, July 6 (Crosby).
Chrysops univittatus, *Macq.*, Chatham, August 25.

Syrphus americanus, *Wied.*, Chatham, August 23.
Musca domestica, *Linn.*, Chatham, August 29.
Phorocera doryphoræ, *Riley*, Chatham, July 9 (Geis.).
Juonia apicifera (?) *Walk.*, Chatham, August 22.
Juonia sp., Chatham, August 23.
Meromyza americana, *Fitch.*, Chatham, July 17 (Geis.).

Order Siphonaptera:
Pulex irritans, Linn., *Chatham*, August 28, 1900.

Order Coleoptera:
Cicindela vulgaris, *Say.*, Chatham, August 28.
Cicindela 12-guttata, *Deg.*, Chatham, August 28.
Chlaenius sericeus, *Forst.*, Chatham, August 7 (Crosby).
Harpalus caliginosus, *Fab.*, Chatham, August 28.
Elaphrus sp., Chatham, August 28.
Acilius sp., Chatham, August 28.
Silpha noveboracensis, *Forst.*, Chatham, August 6 (Crosby).
Silpha lapponica, *Hbst.*, Chatham, August 6 (Crosby).
Coccinella transverso-guttata, *Fab.*, Chatham, August 28.
Coccinella 9-notata, *Hbst.*, Chatham, August 22.
Coccinella trifasciata, *Linn.*, Au Train Falls, August 29.
Coccinella sanguinea, *Linn.*, Chatham, August 28.
Hippodamia 13-punctata, *Linn.*, Chatham, July 12 (Crosby).
Hyperaspis bigeminata, *Rand.*, Chatham, September 1.
Cucujus clavipes, *Fab.*, Munising Junction, August 21.
Ips fasciatus, *Oliv.*, Chatham, September 1.
Dicerca divaricata, *Say.*, Chatham, July 7 (Crosby).
Buprestis fasciata, *Fab.*, Chatham, August 28.
Melanophila longipes, *Say.*, Chatham, August 21.
Chrysobothris femorata, *Fab.*, Chatham, July 7 (Crosby).
Calopteron terminale, *Say.*, Chatham, August 28.
Platerus sp., Chatham, September 3.
Geotrupes sp., Chatham, September 1.
Trichodes nuttalli, *Kirb.*, Chatham, July 14 (Crosby).
Euphoria inda, *Linn.*, Chatham (Crosby).
Trichius affinis, *Gorg.*, Chatham, July 5 (Crosby).
Clytanthus ruricola, *Oliv.*, Chatham (Crosby).
Bellamira scalaris, *Say.*, Chatham, August 4 (Crosby).
Leptura canadensis, *Fab.*, Chatham, July 7 (Crosby).
Leptura proxima, *Say.*, Chatham (Crosby).
Leptura sp., Chatham, July 7 (Crosby).
Monohammus confusor, *Kirb.*, Chatham (Crosby).
Monohammus sp., Chatham, July 14 (Crosby).
Saperda vestita, *Say.*, Chatham, August 28.
Chrysochus auratus, *Fab.*, Chatham (Crosby).
Galerucella cavicollis, *Le C.*, Au Train Falls, August 29.
Diabrotica—12-punctata, *Oliv.*, Chatham, August 28.
Phellopsis porcata, *Lec*, Munising Junction, August 21.
Nyctobates pennsylvanica, *De G.*, Chatham, August 28.
Upis cerambycoides, *Linn.*, Chatham, August 28.
Boletotherus bifurcus, *Fab.*, Munising Junction, August 21.
Meloë sp., Chatham (Crosby).
Dendroctonus trebrans, *Oliv.*, Munising, August 26.
Catoparis lunatus, *Fab.*, Chatham, September 1.

Order Hymenoptera:
Tremex columba, *Linn.*, Chatham, August 28.
Sirex sp., Chatham, August 22.
Ichneumon grandis, *Brul.*, Chatham, August 22.
Thalessa lunator, *Fabr.*, Chatham, August 22.
Ophion sp., Munising, August 26.
Odynerus sp., Chatham, August 23.
Vespa diabolica, *Sauss.*, Chatham, August 22.
Bombus pennsylvanica, *De G.*, Chatham, August 28.
Bombus praticola, *Kirby*, Chatham, August 23, and Munising, August 26.
Bombus sp., Chatham, August 22.

SOILS OF THE UPPER PENINSULA.

BY A. C. LANE, STATE GEOLOGIST.

It is not easy to say very much of value regarding the soils of the Upper Peninsula in a few words, because, with some exceptions, they are confined to rather small areas. One noticeable character of the Upper Peninsula, as compared with the Lower, is the relative shallowness of the soils and sub-soils, so that exposures of bed rock are much more frequent, though there are places where the surface deposits are much over 100 feet thick. The Great Lakes were at one time higher than at present—some 600 feet higher on Keweenaw Point, and from that varying down to 200 or 300 feet around Menominee. Consequently, except as modified by the cutting of the streams below the level mentioned, the soils are arranged in long lines, parallel roughly to the shore, and consisting of strips which are sandy and gravelly, backed with marshes, alternating with clay. The sand or gravel deposits mark the old beach lines of permanent level, and the clay the levels from which the water retired very rapidly. It may be expected that the higher levels would be somewhat more gravelly than the lower, which consist of rehandled material, but this is liable to many exceptions where the shore cuts into bed rock. In many cases this old beach line has been piled up into dunes, which travel back from the shore in line after line, between which are narrow swamps with a soil of muck, shells and clay. Above the highest level of the lakes, where the lake deposits have been removed, we expect to find some deposits of glacial dump soils, known as till, or overwashed sands or gravels deposited by the waters of the melting ice, or clays deposited in lakes dammed by the ice. We find, however, that a very large part of the highlands have been washed and burnt bare, the most conspicuous exception being certain parts of the Copper Range, upon the summit of which are piled overwashed deposits of sand and gravel, full of kettle holes and lakes. These glacial deposits may be also exposed by erosion at lower levels, and as a matter of fact we find in a great many places a very fine-grained pink clay, which often lies under a coarser deposit of sand, gravel or clay. These clays of the Upper Peninsula are generally somewhat calcareous, and in Part I of Vol. 8 of our reports, just issued, will be found four or five analyses. They also contain quite a little iron, which is natural when we consider that they come from the region of iron-bearing rocks. The cold and damp climate favors the growth of peat moss, and we find very extensive deposits along the Upper Taquamenon and Manistique rivers, and small deposits will be found elsewhere.

The celery of Newberry bids fair to rival in character that of Kalamazoo, and about the southeastern part of the peninsula, where the sub-soil is limestone and the waters limy and marl in the lakes not infrequent, it is probable that there will be little difficulty with the souring of this soil.

The ice moved in a general way parallel to the course of the lakes, and hence more from the east than in the Lower Peninsula, and in the region of the sedimentary rocks which lie east of the line from Marquette to Menominee, the course of the underlying bed rock runs very much the same, so that the vast bulk of the materials of the soils comes from the underlying lakes. Consequently in the northern part, following the outcrops of sandstone shown on our map of the Upper Peninsula, the soil is prevailingly sandy, and the rehandling by the ice of Lake Superior has only served to make it more so. On the other hand, as we approach Lake Michigan we get into the belt of the Trenton limestone and the Cincinnati beds, and the very same formations which make the famous and fertile "blue grass" region of Kentucky.

This formation contains a great many fossils and brachipoids with phosphatic shells, and I know of no reason why they should not be as good soils as in Kentucky, of course leaving out of account the difference in climate. And south of these and the beds of the overlying Niagara limestone in the Helderberg, we may find good beds of gypsum, which furnish an excellent soil. The Upper Peninsula Experiment Station, Chatham, lies toward the north margin of the limestone belts, and the excellent farms and fruit around Menominee show in a practical way the good quality of the land. Of course, we have the sandy strips already mentioned, and there are many small lakes, often without outlets, but the sand is rarely too deep for orchards. When we come to the iron country in Marquette, Baraga, Iron, Dickinson and Gogebic counties, we are in a region where now-a-days fire has generally swept more than once. The hills are washed bare of soil and usually rise without much regularity in smooth, round knobs, while between these are streams, which were often dammed by the beavers into a succession of beaver meadows. Two or three Iron county clays will be found analyzed in our paper on "Clays and Shales," by Professor Ries.

Beyond the iron country we come into a long trough, which forms an extension to Keweenaw Bay, and extends a little west of Gogebic Lake. This is underlain by sandstone and the soil is generally sandy, and it was at one time covered with a dense growth of pine. I think the finest view of pine I have ever seen was in the drive from Norwich mine to Matchwood, where the road runs as through colonnades of an endless cathedral. On the north side of this area, which also extends up the east side of Keweenaw Point to Lac La Belle, lies the Copper Range. This is in general covered with a heavy growth of sugar maple, though on the top, where are the overwashed sand and gravel of the ice age, there has been not a little pine and hemlock, and this growth of hardwood indicates the good character of the soil, which is somewhat more clayey.

The basic rocks of which the Copper Range is mainly composed, weather down into an impure red clay, and as the rocks themselves contain a relatively large per cent of phosphorus and soda, it may be expected that the clays will be fertile. Such has been the experience in other regions as to clays which come from the disintegration of such rocks.

I should, perhaps, mention in regard to this sandy region south of the Copper Range, that analyses of the underlying sandstone show relatively high per cent of feldspar, amounting in some cases to one-third of the rock, so that the sandy soils derived therefrom should have, therefore, a good per cent of potash, which would be slowly yielded by decomposition, to the permanent enrichment of the soils.

REPORT OF SOUTH HAVEN SUB-STATION.

BY S. H. FULTON.

Bulletin 187,—Horticultural Department.

PROF. L. R. TAFT, *Horticulturist:*

Sir—The following report upon the work of the South Haven sub-station for the year 1900 is herewith submitted:

With the exception of cherries and grapes, all kinds of fruits on trial bore heavily during the past season. Early plums and peaches were badly affected during the middle and latter part of summer by rot induced by unusually heavy and protracted rains, which occurred during that period. Later varieties very largely escaped the disease, and matured in good condition. Apples and pears were of good quality and quite free from scab and worms. Unfortunately most of the fruit of the late fall and winter varieties was blown down before mature by a high windstorm on September 11 and 12.

Spraying has been attended by unusually good results, especially in the control of the leaf curl of the peach and the scab and codling moth of the apple and pear. Arsenite of lime proved more satisfactory than paris green heretofore used.

On the following pages the current year's record of all varieties in fruiting is given in tabulated form, together with short descriptions of all the new and many of the older varieties on trial. Results of tests in pruning, spraying, thinning, etc., are reviewed with notes upon the general care of the orchards and grounds.

RASPBERRIES.

Cumberland, Doolittle, Eureka, Livingston and Smith Prolific were the most productive of the black caps this season. These varieties, except Doolittle and Livingston, which are inclined to bear too much small fruit, are recommended for general cultivation. Conrath, Diamond, Gregg, Idaho, Kansas and Smith Giant are also reliable and most of them well known kinds. Columbian and Shaffer were the most productive of the purple caps, and are the only varieties of this class on trial which can be recommended for profit. Of the two, Columbian is preferable. Among the red varieties, Cuthbert, Loudon, Marlboro, Miller and Turner gave the largest yields. For general planting Cuthbert, Loudon and Marlboro are especially desirable.

RED VARIETIES.

Brandywine.—An old variety once popular for market planting, but now largely replaced by better kinds. Lacks size and productiveness here.

Church.—Ripens a little in advance of Cuthbert. Plants vigorous and usually quite productive. A good home berry, but rather soft for market.

Cuthbert.—This old, well known variety still holds first place among the red raspberries in the station collection. None of the newer kinds equal it in plant vigor and productiveness.

Early King.—A fairly good early berry, but not equal to Marlboro and Miller. The fruit is inclined to be rather small.

Hansell.—Very early, but unprofitable, because lacking in vigor and productiveness.

Herstine.—A large, bright red berry of best quality. Fruits over a longer season than almost any other variety on trial. Valuable for home use, but not productive enough for market.

Loudon.—This large, handsome berry has attracted more attention than any other of the newer kinds. It was raised by F. W. Loudon, of Wisconsin, from seed of

TABULATION OF RASPBERRIES, 1900.

Abbreviations—c, conical; o, oblate; ob, oblong; r, roundish; p. pubescent; b, blackish; pu, purplish; r, red; y, yellow.

Name.	Species.	Bloom.	First picking.	Last picking.	Product (1-10).	Form.	Color.	Average weight (ounces).	Quality (1-10).
American Everbearing	Occidentalis	June 3	July 6	July 13	7	r o	b	.025	3
Brandywine	Strigosus	" 7	" 13	" 30	7	r	r	.05	7
Cardinal	Neglectus	" 8	" 11	" 27	7	r c	r	.062	7
Carman	Occidentalis	" 3	" 6	" 15	8	r	b	.037	6
Caroline	Neglectus	" 4	" 6	" 27	8	r	y	.05	2
Centennial	Occidentalis	" 4	" 11	" 18	8	r	b	.025	4
Church	Strigosus	" 8	" 11	Aug. 1	5	r	r	.05	8
Clark	Occidentalis	" 4	" 6	July 18	7	r	b	.025	6
Columbian	Neglectus	" 12	" 16	Aug. 2	10	r	pu	.062	6
Conrath	Occidentalis	" 4	" 6	July 19	8	r	b	.037	5
Cromwell	Occidentalis	" 4	" 6	" 18	9	r	b	.025	5
Cumberland	Occidentalis	" 4	" 12	Aug. 1	10	r c	b	.062	7
Cuthbert	Strigosus	" 10	" 14	" 1	9	c	r	.075	6
Diamond	Occidentalis	" 4	" 11	July 28	9	r	b	.037	7
Doolittle	Occidentalis	" 4	" 6	" 14	10	r	b	.05	5
Earhart	Occidentalis	" 4	" 6	" 14	9	r	b	.025	3
Early King	Strigosus	" 4	" 6	" 27	8	r o	r	.062	7
Emmet	Neglectus	" 8	" 11	" 27	7	r	pu	.05	3
Eureka	Occidentalis	" 4	" 6	" 22	10	r o	b	.05	6
Farnsworth	Occidentalis	" 4	" 11	" 14	9	r o	b	.025	4
Gladstone	Neglectus	" 7	" 6	" 16	5	r c	pu	.025	5
Golden Queen	Strigosus	" 10	" 14	" 28	8	r c	y	.075	7
Gregg	Occidentalis	" 4	" 11	" 19	7	r o	b	.05	6
Green	Occidentalis	" 4	" 6	" 19	8	r	b	.05	7
Hansell	Strigosus	" 8	" 6	" 25	3	r	r	.037	6
Herstine	Idaeus hyb. ?	" 4	" 11	" 30	6	r	r	.075	9
Hilborn	Occidentalis	" 4	" 11	" 19	9	r o	b	.037	6
Idaho	Occidentalis	" 5	" 12	Aug. 1	9	r o	b	.05	6
Indiana	Occidentalis	" 4	" 11	July 27	8	r o	b	.05	5
Jap. Wineberry	Phoenicolasius	" 19	Aug. 1	Aug. 25	8	r o	r	.025	1
Johnston	Occidentalis	" 6	July 11	July 19	8	r o	b	.037	7
Kansas	Occidentalis	" 4	" 11	" 27	9	r o	b	.06	7
Livingston	Occidentalis	" 6	" 11	" 28	10	r o	b	.037	5
Logan	Vit. x Idaeus ?	" 4	" 11	" 25	7	l c	r pu	.2	5
Loudon	Strigosus	" 9	" 11	" 30	9	r c	r	.075	5
Lovett	Occidentalis	" 4	" 6	" 19	6	r o	b	.037	10
Marlboro	Strigosus	" 8	" 6	" 25	9	r c	r	.062	6
Miller	Strigosus	" 8	" 6	" 22	6	r o	r	.05	8
Mills No. 15	Occidentalis	" 4	" 12	" 28	8	r	b	.037	6
Munger	Strigosus	" 11	" 11	Aug. 1	7	r c	r	.075	4
Muskingum	Neglectus	" 11	" 16	July 26	8	r o	pu	.05	5
Nemaha	Occidentalis	" 4	" 11	" 22	8	r o	b	.05	6
Ohio	Occidentalis	" 4	" 11	" 6	7	r o	b	.025	6
Older	Occidentalis	" 4	" 7	" 18	8	r o	b	.05	5
Onondaga	Occidentalis	" 4	" 11	" 20	8	r	b	.05	6
Palmer	Occidentalis	" 4	" 6	" 18	9	r	b	.025	7
Phœnix	Strigosus	" 11	" 11	Aug. 1	8	r o	r	.05	7
Progress	Occidentalis	" 4	" 6	July 17	8	r	b	.025	5
Redfield	Neglectus	" 11	" 11	" 19	7	r	pu	.037	3
Rubus Xanthocarpus	R. Xanthocarpus.	" 4	" 16	" 25	3	r o	y	.03	1-2
Sarah	Strigosus	" 11	" 14	" 27	3	r o	r	.05	5
Shaffer	Neglectus.	" 12	" 14	" 30	8	r	pu	.05	6
Smith Giant	Occidentalis	" 6	" 11	" 22	9	r	b	.062	6
Smith Prolific	Occidentalis	" 4	" 11	" 28	10	r o	b	.062	8
Souhegan	Occidentalis	" 4	" 6	" 18	8	r o	b	.037	7
Strawberry-raspberry	Rosaefolius	" 19	" 19	Aug. 15	10	c	r	.2	2
Superlative	Idaeus	" 8	" 11	July 22	8	c	r	.05	4
Thwack	Strigosus	" 8	" 6	" 27	4	r	r	.05	6
Turner	Strigosus	" 11	" 11	" 27	8	r	r	.05	8
Tyler	Occidentalis	" 4	" 6	" 14	9	r	b	.037	6
Winona	Occidentalis	" 4	" 6	" 15	8	r o	b	.025	5

Turner, crossed with Cuthbert. The plants are hardy and productive, but not quite as vigorous as could be desired. The firmness of the fruit, together with its large size and attractive appearance, renders the Loudon popular as a market sort, where the plants can be made to do well. In quality it is not quite equal to Cuthbert.

Marlboro.—Vigorous and productive. Fruit large, firm and attractive. The best early variety at South Haven.

Miller.—Lacks vigor and productiveness here and the fruit is inclined to be rather small. Ripens with Marlboro, and in some localities succeeds much better than the latter variety.

Sarah.—The fruit of this variety is of large size and attractive appearance, but the plants are unproductive.

Superlative.—One of the European varieties, which, as a class, are not considered sufficiently hardy for this climate. The Superlative has stood the winters here remarkably well, but the plants are poor growers and not very productive.

Turner.—A good, thrifty grower and quite productive. Desirable in localities where great hardiness is required.

BLACK CAPS.

Carman.—The plants lack vigor and the fruit is small.

Centennial.—Vigorous and productive. A good variety for either home or market.

Clark.—Fruit small and seedy. A failure here.

Conrath.—A profitable variety, ripening a few days in advance of Gregg. Strong grower, productive, stands drouth well. The berries are large and firm, but not of high quality.

Cumberland.—This new variety has again made an excellent showing on the station grounds. Plants vigorous and productive. Berries large, firm and of good quality. Ripens after Palmer and continues in fruiting a long time. Should be tried by all raspberry growers.

Diamond.—A late ripening, strong growing variety, valuable for market. Fruit large and of high flavor. Holds out well in size to end of season.

Eureka.—The most productive medium early variety fruited this season. The plants are vigorous and the fruit is large and attractive. A valuable variety both for home and market.

Farnsworth.—A remarkably strong growing variety, which at first promised to be valuable, but the last two seasons the berries have been small and of poor quality. Cannot be recommended.

Gregg.—An old, well known market variety. Vigorous and productive, but not fully hardy. The berries are large, firm, and of good quality.

Green.—A vigorous growing, early ripening variety, which this season produced a good crop of berries of large size. Ordinarily the fruit has been rather small, and for this reason the variety is not considered very reliable.

Idaho.—A late ripening variety which seems to be but little known. It has been on trial here for several years and has proven to be one of the best of the late kinds. The plants are vigorous and the fruit is of largest size. Many fine berries are borne on canes of the current year's growth after nearly all other varieties are through fruiting.

Kansas.—Rated as one of the best mid-season varieties. Here it has proven very productive, but the fruit has not always been as large as could be desired. The plants are very strong growers.

Livingston.—A new variety received from Utica, Mo., in 1898. The plants are vigorous and very productive, but the fruit is small and of only fair quality. Not considered promising.

Older.—The plants are good growers, but the fruit is small and crumbles badly in picking. A failure here.

Smith (Prolific).—A good, thrifty grower and quite productive. The berries are large and firm, and have a rich, sweet flavor. One of the best mid-season varieties.

Winona.—Lacks size and productiveness. Fruits over a very short season. A failure here.

PURPLE CAPS.

Cardinal.—This variety comes highly recommended from Kansas. Here it proves to be a strong grower and quite productive, but the last two seasons the fruit has been rather small. Does not equal Columbian and Shaffer.

Columbian.—Vigorous, hardy and very productive of berries of the largest size. The best of the hybrid or purple cane class. Particularly valuable for culinary purposes.

Emmet.—Received from A. H. Griesa, Lawrence, Kansas, in 1895. A small to medium grower, moderately productive of fruit of large size, but rather low quality.

Gladstone.—Fruit small and crumbles so badly in picking as to render the variety almost worthless. The plants are very strong growers.

Redfield.—A hardy variety from Iowa, which has fruited here several seasons. The berries are smaller than Columbian and a little too dark in color to make a good appearance. The plants grow well and produce fair crops.

Shaffer.—Ranks next to Columbian for profit. Similar to Columbian in habit of growth, productiveness and size of fruit, but of a more delicate texture and requires more careful handling.

RASPBERRY NOVELTIES.

Japanese Mayberry.—Received from Parry Bros., of Parry, N. J., in 1897. The plant has grown to the height of about three feet, making a very pretty little bush, but it has not yet fruited. It is tender and requires winter protection. Its behavior up to the present time does not indicate that it will be likely to prove of any value.

Logan Berry.—This widely disseminated novelty is supposed to be a cross between a wild creeping blackberry of California and one of the European raspberries. The plant is a slow grower of trailing habit, requiring winter protection. The berries are large, long, conical, of a reddish purple color, and a mild, raspberry-like flavor. Fruited sparingly last year, which was the fourth season after planting, and this year bore a fair crop. A failure so far as all practical purposes are concerned.

Rubus Xanthocarpus.—A low spreading plant from Russia, resembling the strawberry raspberry. The berry is small and yellow, with few grains, and has a mild, indistinct flavor. It is difficult to see wherein this plant can prove of value.

Strawberry Raspberry.—This plant has been well tested in many parts of the country, and under a great variety of conditions, and it is now quite generally known that it can be regarded as little short of a monumental humbug of the nurserymen who have disseminated it. The fruit, although showy and attractive, is worthless, and the plant, which propagates by root stocks and suckers freely, behaves like a weed.

Wineberry.—Another Japanese introduction, which has no value unless it may be for ornamental purposes. The foliage and flowers are attractive in appearance. The plant is an upright grower, attaining the height of about six feet. The stout canes are of a light yellowish color; leaves large, thick, leathery; flowers large, showy, pink in color; berry a thin red cap born upon a large peduncle. The fruit is dry and seedy, with very little flavor.

BLACKBERRIES.

The blackberry crop this season was good, considering the fact that nearly all varieties in the station collection suffered more or less from winter killing during the winter of 1898-9. No doubt the good showing made can be largely attributed to an abundant rainfall and other favorable conditions, which existed up to and through the time of fruiting.

Early King was the most productive of the early varieties. Wallace, a mid-season variety, gave a larger yield than any other. It is a large, oblong, irregular berry, of good quality. Among the late kinds, Fruitland was the most productive, but it is not as large nor as good a berry as Ohmer, which ripens at the same time.

NOTES ON VARIETIES.

Ancient Briton.—A strong, upright grower. Usually quite productive, but the berries are inclined to run small and thus render the variety unprofitable.

Childs (Tree).—A low, dwarfish, leafy grower, lacking both in hardiness and productiveness. A failure here.

Early Harvest.—Largely grown for early market. A good berry, but rather small. The plants are tender and usually require some winter protection.

Early King.—Better than Early Harvest this season. The berries are large and of good quality. In point of hardiness the plants are very similar to Early Harvest.

TABULATION OF BLACKBERRIES, 1900.

Abbreviations—i, irregular; o, oblong; ov, oval; r, roundish.

Name.	Bloom.	First picking.	Last picking.	Product (1-10).	Form.	Weight in oz.	Quality (1-10).
Agawam	June 8	July 27	Aug. 10	8	o	.175	8
Ancient Briton	" 4	" 27	" 11	9	r o	.137	7
Childs' Tree	" 9	" 27	" 6	3	r o v	.15	5
Early Harvest	" 8	" 16	" 4	8	o	.062	6
Early King	" 7	" 18	" 6	9	o	.075	7
Early Mammoth	" 4	" 27	" 10	8	o i	.2	7
Eldorado	" 4	" 26	" 12	10	o	.125	8
Erie	" 8	" 28	" 10	8	o v	.175	7
Fruitland	" 8	Aug. 3	" 15	8	r o v	.11	8
Kittatinny	" 8	July 27	" 12	10	o	.15	6
Knox	" 4	" 27	" 15	10	i o	.15	7
Lawton	" 7	" 27	" 16	10	o	.15	7
Lincoln	" 4	" 30	" 13	8	i o	.125	8
Lovett	" 4	" 31	" 16	7	r o v	.1	6
Maxwell	" 8	" 27	" 7	4	i o	.15	6
Minnewaska	" 8	" 31	" 13	8	r o	.175	6
Nevada	" 8	" 28	" 15	9	o	.15	8
Ohmer	" 8	" 30	" 20	6	r	.15	6
Oregon	" 12	Aug. 27	Sept. 15	9	o v	.075	4
Piasa	" 4	July 27	Aug. 8	5	i o	.1	6
Reyner	" 8	" 31	" 15	6	i o	.075	8
Sanford	" 4	" 31	" 15	9	r o v	.62	8
Snyder	" 4	" 27	" 12	7	r o v	.1	7
Taylor	" 4	" 30	" 15	7	r o	.1	9
Thompson	" 5	" 25	" 10	7	i o	.175	5
Triumph	" 4	" 27	" 13	9	r o	.075	8
Wallace	" 8	" 27	" 15	10	i o	.15	8
Wilson	" 8	" 24	" 13	8	i o	.175	5
Wilson, Jr.	" 8	" 24	" 13	8	i o	.175	5

Early Mammoth.—One of the hardiest of the early kinds and usually quite productive. The berries are of large size and quite good quality.

Eldorado.—A hardy and productive variety, resembling Snyder in growth of plant. The fruit is of medium size, firm texture, and good quality. One of the best of the newer kinds.

Erie.—A very large berry of fine appearance, but rather acid. The plants are vigorous and hardy, but not very productive.

Fruitland.—One of the latest in time of ripening. The berries are of medium size and fair quality. Of some value both for home use and market.

Kittatinny.—A well known mid-season variety which has been widely grown because of its vigor of plant and large, well flavored fruit. It has exhibited a fair degree of hardiness here, and has usually been quite productive. In some localities it seems to be especially liable to the attack of red rust.

Knox.—This variety is reported to lack productiveness, but it has borne very well here. The plants are strong and upright in growth, and are quite hardy. Berries large and of good quality. Ripens with Snyder.

Lawton.—An old, well known, hardy variety, vigorous and productive. The fruit is large and of good quality.

Lincoln.—A hardy variety which has usually done well here, but this season the berries were rather small. It ranks high in productiveness and is of good quality.

Lovett.—The plants are rather tender and the berries small and of only fair quality.

Maxwell.—Plants lack vigor and productiveness. The berries are large, of loose texture, and rather low quality. A failure here.

Minnewaska.—A strong grower, quite productive of berries of large size and good quality. A valuable kind for general planting. Ripens a few days later than Snyder.

Nevada.—A strong, upright grower, producing in abundance sweet, rich berries of large size. A very good, medium late variety.

Ohmer.—A spreading, rather slender grower, moderately productive of berries of large size and good quality. A good late berry.

Piasa.—Plant low and spreading, inclined to be unproductive. The berries are of small size and only fair quality.

Reyner.—Gives unsatisfactory results here. The berries are small and the plants unproductive.

Sanford.—Bears heavily, but the fruit is too small to be classed of much value.

Thompson.—Plants upright in growth, moderately vigorous, inclined to be tender. Berries very large, of medium quality. Not a profitable kind.

Wallace.—A hardy, vigorous variety from Wisconsin. The fruit is very large, oblong, of good quality, mild and pleasant. A regular and very abundant bearer. Gave the largest yield of any variety on trial this season.

Wilson.—Plant moderately vigorous, inclined to be tender. The berries are very large and of fair to good quality. A profitable market variety.

Wilson, Jr.—Practically identical with Wilson.

CURRANTS.

London Market, Victoria and Wilder were the most productive varieties fruited this season. London Market is one of the most profitable market varieties grown. Wilder is a large fruited kind, excelling Cherry and Fay in plant vigor and productiveness. White Dutch is one of the best white varieties on trial, while Champion, English and Wales excel among the black kinds.

TABULATION OF CURRANTS, 1900.

Key: Form—r, roundish. Color—b, black; r, red; w, white. Use—d, dessert; k, kitchen; m, market.

Name.	Origin.	Planted.	Bloom.	Ripe.	Product (1-10).	Form.	Color.	Quality.	Vigor.	Weight in oz.	Use.
Champion........	England	1889	May 7	July 20	9	r	b	6	8	.075	k m
Cherry..........	Europe.........	1888	" 4	" 12	7	r	r	6	6	.1	k m
English	England	1892	" 17	" 22	8	r	b	4	10	.075	k m
Fay	New York	1888	" 4	" 12	8	r	r	6	5	.1	k m
Holland	Europe.........	1889	" 7	" 14	7	r	r	4	7	.05	k
Lakewood........	Ohio	1890	" 4	" 12	8	r	r	6	8	.15	k m
Lancaster	....	1898	" 8	" 12	7	r	w	8	7	.075	d m
Lee...............	America........	1888	" 17	" 21	7	r	b	4	5	.1	k m
London	England........	1890	" 6	" 12	10	r	r	5	10	.15	k m
No. 22...........	....	1898	" 8	" 12	4	r	r	6	6	.1	......
No. 28...........	....	1898	" 4	" 12	4	r	r	6	6	.125	......
No. 29...	....	1898	" 4	" 12	6	r	r	4	7	.15	......
North Star.......	Minnesota......	1890	" 4	" 12	8	r	r	8	10	.125	k m
Pomona..........	Indiana	1897	" 4	" 12	9	r	r	7	6	.2	k m
Red Dutch.......	Europe.........	1888	" 4	" 14	7	r	r	8	10	.15	k m
Ruby Castle.....	Europe.........	1892	" 6	" 12	9	r	r	5	9	.2	k m
Ruby, Moore.....	New York......	1890	" 4	" 12	7	r	r	8	6	.125	k m
Saunders	Ontario.........	1890	" 17	" 20	8	r	b	4	8	.075	k m
Select............	Massachusetts..	1890	" 4	" 12	9	r	r	5	7	.2	k m
Versaillaise......	France	1888	" 4	" 12	9	r	r	6	8	.15	k m
Victoria	England	1888	" 8	" 12	10	r	r	6	9	.075	k m
Wales............	Ontario.........	1890	" 17	" 21	9	r	b	5	10	.1	k m
White Dutch....	Europe	1888	" 4	" 12	9	r	w	10	9	.1	d m
White Gondoin..	Europe	1890	" 8	" 11	8	r	w	9	7	.075	d m
White Grape.....	Europe	1888	" 7	" 11	8	r	w	8	9	.075	k m d
Wilder...........	New York......	1890	" 9	" 12	10	r	r	6	10	.15	k m

NOTES ON VARIETIES.

Cherry.—Well known. Rather a poor grower and quite subject to the attack of twig borers. However, large size and handsome appearance, bring for this variety the highest price in market, and it is therefore a profitable kind to grow if insect pests are controlled.

Fay.—Closely resembles Cherry, and even more subject to the attack of the twig borer.

Holland.—A vigorous grower and moderately productive. Has some value as a market sort, but is not equal to London, Wilder and other varieties on trial. The plants are very subject to the attack of plant lice.

Lakewood.—Resembles Cherry, but is a little better grower and more productive than that variety.

Lancaster.—A white currant of quite good quality. The plants are vigorous and moderately productive.

London.—Plants vigorous and very productive. Clusters large, moderately compact. Quality fair to good. One of the most profitable market varieties grown.

North Star.—A comparatively new variety from Minnesota. The plant is tall, upright, vigorous and productive. The bunches are long and moderately compact. Quality good. A fairly good home and market currant.

Pomona.—A new variety which originated in Indiana. Planted in 1897 and thus far is slightly lacking in vigor, but bids fair to be quite productive. Clusters of medium length, moderately compact; berries medium to large, of good quality. Requires further trial.

Red Dutch.—An old variety. Quite productive, but rather small for market. The plants are the tallest, strongest growers in the station collection.

Ruby Moore.—A weak grower. The berries are of medium size and quite good quality. Not profitable.

Select.—Somewhat lacking in vigor and productiveness. Belongs to the Cherry class.

Versaillaise.—Fairly vigorous and quite productive. Berries above medium in size and of good quality; clusters long and compact. Ranks well as a market sort.

Victoria.—An old, well known market sort. The berries are of good quality, but quite small. This variety is giving way to the larger kinds.

White Dutch.—A valuable white currant for home use. Vigorous and productive. Quality best.

Wilder.—Of the Cherry type, but a better grower than Cherry and more productive. The plants are tall, upright, slightly spreading, vigorous. Bunches large, long and compact. Quality very good. The most profitable large fruited kind on trial.

GOOSEBERRIES.

Among the English varieties Chautauqua and Lancashire gave the best results this season. Keepsake, a variety which has heretofore made an excellent showing, fruited rather sparsely this season, and was somewhat affected with mildew. Downing, Red Jacket and Pearl were the most productive of the American kinds. Red Jacket and Pearl are new varieties of considerable merit, but they were not qnite equal to Downing this season.

The use of liver of sulphur spray for the prevention of mildew was not attended with quite as good results as usual. This may doubtless be attributed to lack of strength of the material used for the first spraying, and to conditions of weather, which favored uncommon activity of the disease. Some of the American varieties which, as a class, are usually quite exempt from mildew, were more or less affected.

ENGLISH VARIETIES.

Apex.—A good, thrifty grower, quite free from mildew. The berries are large and of good quality. Color greenish yellow.

Auburn.—A very large, light-colored berry. The plants lack vigor.

Bendelon.—Rather a weak grower and subject to the attack of leaf diseases. Berry large, yellowish green, of fair quality.

Chautauqua.—A thrifty grower and quite productive. This season the plants were loaded with berries of large size, good quality, and free from mildew. One of the best on trial.

Columbus.—A good grower and productive of berries of large size and very good quality. Color yellowish green. Mildewed badly this season.

Industry.—Rather a poor grower and only moderately productive. Quite subject to mildew. Turns red when ripe, which is an objection to it for market purposes.

Keepsake.—Heretofore one of the best, but this season the berries mildewed considerably and were somewhat undersized. Usually of largest size, best quality and a profitable kind. Color greenish yellow.

Lancashire.—A vigorous grower and very productive. Berries large and of good quality, but they have the fault of turning red when ripe. One of the best except for color.

Orange.—A remarkably strong growing variety. Berries small, yellowish, thin-skinned, of best quality. Of no value for market.

Triumph.—Practically identical with Columbus, and there seems to be little need of keeping these varieties distinct.

TABULATION OF GOOSEBERRIES, 1900.

Key.—Form—l, long; o, oval; r, round. Color—g, green; r, red; w, white; y, yellow.

Name.	Species.	Planted.	Bloom.	Ripe.	Form.	Color.	Weight in oz.	Product.	Quality (1–10).	Vigor (1–10).
Apex	Grossularia	1893	May 4	July 10	o	y g	.12	8	9	6
Auburn	Grossularia	1890	" 4	" 10	o	g r	.12	6	8	5
Bendelon	Grossularia	1894	" 4	" 10	o	y g	.1	8	5	6
Champion	Grossularia	1891	" 8	" 9	r o	y g	.075	9	6	10
Chautauqua	Grossularia	1892	" 4	" 10	r o	g y	.175	10	8	9
Columbus	Grossularia	1894	" 4	" 9	r o	y g	.162	7	9	8
Downing	Oxyacanthoides	1888	" 4	" 7	r o	w g	.1	9	7	10
Golden	Grossularia	1891	" 4	" 10	o	y	.11	3	6	7
Houghton	Oxyacanthoides	1888	" 10	" 9	r o	r	.075	8	10	10
Industry	Grossularia	1889	" 4	" 9	r o	r	.125	5	6	7
Keepsake	Grossularia	1894	" 4	" 10	o	y g	.15	7	8	7
Lancashire	Grossularia	1894	" 4	" 9	o	g r	.175	9	7	8
Orange	Grossularia	1890	" 4	" 6	r o	y g	.087	7	10	10
Pale Red	Oxyacanthoides	1890	" 4	" 9	r o	r g	.075	9	9	10
Pearl	Oxyacanthoides	1890	" 4	" 9	r o	g	.1	8	9	7
Red Jacket	Oxyacanthoides	1890	" 4	" 7	r o	r g	.125	10	8	8
Smith	Oxyacanthoides	1888	" 4	" 10	o	g	.087	5	8	3
Strubler	Cynosbati	1892	" 4	" 9	r o	g y r	.087	4	7	4
Tree	Cynosbati	1892	" 8	" 10	r o	r	.075	5	5	7
Triumph	Grossularia	1890	" 4	" 10	r o	g y	.16	8	8	8

AMERICAN VARIETIES.

Downing.—An old standard variety largely grown. Vigorous and usually very productive. Still heads the list as a market sort, and is the best of the American kinds on trial.

Pale Red.—A good grower and quite productive, but the berries are too small.

Pearl.—Berries closely resemble Downing, but the plants are not as strong in growth as that variety.

Red Jacket. A new variety not very different from Downing in appearance of fruit. Seems to be fully equal to Downing in all respects except plant growth. The latter is more vigorous, making a larger, stronger plant.

Smith.—A poor, weak grower. Drops its foliage badly in midsummer. Berries medium in size and greenish in color. A failure here.

CHERRIES.

The cherry crop, as a whole, was much lighter this year than last, but a number of varieties, particularly among the sour kinds, bore very full. Dyehouse, Montmorency, Ostheimer, Richmond and Weir were among the more productive sour varieties. Of the Duke class, Montrueil and Magnifique gave the largest yields, while Ida, Mary Kirtland, Napoleon, Tartarian and Windsor excelled among the sweet varieties.

A block of trees three years in sod did not make as good a showing this season as trees under cultivation. The yield was less, the fruit smaller in the case of a number of varieties, and many of the trees made almost no growth. The block in question contains thirty-three sweet and sour varieties, and was seeded down to check too rapid growth as well as for comparison with trees under cultivation. An application of ground bone and wood ashes was made upon this block during the second year of the test. This line of treatment proved beneficial the first two years, but the experience of this season would seem to indicate that, if longer left in sod, injury to the trees may result.

An effort was again made this season to straighten out the identity of some of the Russian kinds in the station collection, which are somewhat confused as to name. Prof. G. H. Powell, horticulturist of the Delaware Station, was here during the cherry season making a study of the sour varieties, and kindly lent his aid in the work of identifying varieties not under their true names. A few doubtful kinds still remain, but with slight exceptions it is believed the list of Russian varieties given in the accompanying tabulation is now correct as to name.

MORELLOS.

Baendor.—The tree is a moderately vigorous grower with a round spreading head and peculiar light-colored foliage, which makes this variety readily distinguishable from all other sour varieties on trial. The fruit is very dark red, roundish heart shape, of rather low quality. Seems to be quite unproductive.

Lithaur.—A Russian variety readily distinguishable from others of its class by its tall, upright habit of growth. Fruit long-stemmed, very dark red, almost black. Flesh and juice crimson. Too small to be very valuable.

Lutovka.—The tree is of Duke habit, having stout branches and large, broad leaves, but the large, flattened, red fruit is of the Amarelle type, resembling Montmorency in texture, but is less acid in flavor. A fine fruit, but the tree lacks productiveness. Ripe in early July.

Minnesota.—Tree spreading, moderately vigorous; fruit dark red, flesh and juice crimson. A profitable variety ripening several days later than Montmorency.

Monarch.—Said to be a late ripening Montmorency. Here it ripens with the Montmorency commonly grown, and does not appear very different from that variety. Received from Stark Bros., Louisiana, Mo.

Bessarabian.—A Russian variety. Tree spreading with slightly drooping, short jointed, very leafy branches. Fruit large, dark red, with light red flesh and juice.

Brusseler Braune.—Tree an upright, spreading, thrifty grower. Fruit large, dark red, of good quality. Stem long, usually with small leaf attached to base. Borne singly or in pairs, rarely in threes. A fine late cherry, but rather disappointing as to productiveness. Introduced from Russia.

Dyehouse.—Ripens with Richmond and is very similar to that variety in fruit. Richmond, however, is a much better grower and is to be preferred for general planting.

King.—This variety also ripens in the Richmond season. The fruit is a little larger and longer stemmed than Richmond. Tree a free grower and quite an abundant bearer.

Lancaster.—A spreading, rather drooping grower. Fruit bright, dark scarlet, of good size, and quite good quality. Ripe June 25. Fruits rather sparingly.

Montmorency.—A well known variety and one of the most profitable sour cherries in the station collection. Montmorency and Montmorency Ordinaire, as grown here, prove identical.

Northwest.—Trees low, spreading, dwarfish in habit. Fruit very dark red with crimson flesh and juice. Quite productive. Season medium late.

TABULATION OF CHERRIES, 1900.

Name.	Species.	Planted.	Bloomed.	Ripened.	Weight in ounces.	Product (1–10).	Quality (1–10).	Vigor (1–10).
Abbesse	Duke	1888	May 12	July 10	.15	2	7	10
Angouleme	Duke	1888	“ 12	“ 10	.17	1	8	10
Badacsony	Avium	1894	“ 9	“ 3	.17	6	8	9
Baendor	Morello	1892	“ 14	June 29	.1	1	5	7
Baltavar	Avium	1894	“ 9	July 3	.25	8	8	9
Bessarabian	Morello	1888	“ 12	“ 9	.12	5	5	10
Brusseler Braune	Morello	1888	“ 12	“ 21	.15	4	7	10
Carnation	Duke	1891	“ 12	June 29	.12	7	8	9
Choisy	Duke	1888	“ 12	“ 23	.1	1	10	7
Cleveland	Avium	1888	“ 9	“ 24	.17	8	8	10
Coe	Avium	1888	“ 9	“ 21	.12	8	10	8
Downer	Avium	1888	“ 9	July 4	.12	9	9	8
Dyehouse	Morello	1891	“ 11	June 25	.1	10	5	8
Eagle	Avium	1888	“ 9	July 3	.12	3	10	10
Early Purple	Avium	1892	“ 9	June 16	.12	3	8	8
Elton	Avium	1892	“ 9	“ 20	.15	5	8	8
Eugenie	Duke	1888	“ 9	“ 22	.15	7	8	8
Florence	Avium	1892	“ 9	“ 28	.07	1	6	7
Frauendorfer	Morello	1888	“ 12	July 10	.12	3	6	10
Galopin	Duke	1891	“ 11	“ 9	.2	1	7	9
Hortense	Duke	1888	“ 12	June 28	.16	3	9	7
Ida	Avium	1893	“ 9	“ 21	.15	10	8	9
King	Morello	1891	“ 12	“ 28	.13	7	6	8
La Maurie	Avium	1893	“ 9	“ 19	.08	4	5	7
Lancaster	Morello	1894	“ 12	“ 25	.11	7	6	9
Late Duke	Duke	1890	“ 12	“ 30	.17	3	7	7
Lithaur	Morello	1892	“ 12	July 10	.12	8	5	10
Lutovka	Duke ?	1888	“ 12	“ 6	.17	1	7	10
Magnifique	Duke	1888	“ 15	“ 17	.12	10	7	8
Mary Kirtland	Avium	1891	“ 9	June 21	.15	9	9	8
May Duke	Duke	1888	“ 9	“ 25	.15	2	7	8
Mednyansky	Avium	1894	“ 9	July 4	.15	7	7	6
Minnesota	Morello	1892	“ 12	“ 9	.12	8	5	9
Monarch	Morello	1898	“ 12	“ 5	.12	10	7	9
Montmorency	Morello	1891	“ 12	“ 5	.12	10	7	10
Montrueil	Duke	1891	“ 12	“ 2	.15	10	8	9
Napoleon	Avium	1892	“ 9	June 30	.2	9	7	9
Northwest	Morello	1893	“ 14	July 17	.1	8	5	7
Ohio (Beauty)	Avium	1891	“ 11	June 23	.15	6	6	9
Olivet	Duke	1891	“ 10	“ 28	.12	4	7	11
Ostheim	Morello	1888	“ 12	July 9	.1	7	5	8
Ostheimer	Morello	1893	“ 14	“ 9	.12	10	7	8
Philippe	Morello	1888	“ 9	“ 2	.15	3	7	9
Plymouth Rock	Avium	1896	“ 9	June 23	.12	6	8	9
Purity	Avium	1893	“ 9	“ 29	.1	1	9	6
Richmond	Morello	1892	“ 12	“ 25	.11	9	5	9
Rockport	Avium	1891	“ 9	“ 22	.15	8	8	8
Royal Duke	Duke	1891	“ 12	“ 27	.11	2	7	7
Schmidt	Avium	1894	“ 9	July 3	.2	1	7	10
Sklanka	Morello	1888	“ 12	June 25	.11	6	6	9
Spanish	Avium	1891	“ 9	“ 28	.15	6	10	8
Spate	Morello	1888	“ 12	July 9	.1	7	6	9
Strauss	Morello	1888	“ 12	“ 3	.15	2	6	10
Suda	Morello	1893	“ 14	“ 9	.1	10	4	8
Tartarian	Avium	1888	“ 9	June 29	.16	9	10	9
Weir No. 2	Avium	1891	“ 9	July 3	.15	8	7	9
Windsor	Avium	1891	“ 9	June 21	.12	8	8	9
Wood	Morello	1893	“ 12	“ 26	.13	9	6	8
Wragg	Morello	1892	“ 14	July 17	.1	9	5	8

Ostheim.—Tree spreading, dwarfish. Fruit small, dark red, almost black. Quite productive, but not valuable because of the small size of the fruit. Ripens with Montmorency.

Richmond.—A good grower and an abundant bearer, but the fruit is acid, soft and of rather low quality. Considerably grown for early market, and it is one of the most profitable varieties for that purpose.

Sklanka.—A Russian variety resembling Montmorency in growth of tree, while the fruit is very similar to Richmond, with which variety it ripens. Not so productive as Richmond.

Strauss.—Tree tall and upright in growth, with a dense head. Fruit dark, glossy crimson. Ripe in early July. Rather unproductive.

Suda.—Very productive. Fruit dark red, of quite good quality. The tree is rather dwarfish in growth and ripens its fruit late.

Weir No. 2.—Tree a strong, upright, spreading grower and a good bearer. The fruit is above medium in size and of a light red color. A desirable early variety, ripening with Richmond.

Wragg.—Strongly resembles English Morello. Bears well, but is not a very thrifty grower.

DUKES.

Abbesse.—A very vigorous spreading grower, with perfect foliage. Fruit large, handsome, of good quality. Very unproductive.

Choisy.—An old French variety of best quality. Unproductive here.

Eugenie.—Rather dwarfish in growth. Fruit large, dark red, of very good quality. Fairly productive. A good home cherry, but not profitable for market.

Galopin.—Tree upright, spreading, moderately vigorous. Fruit large, yellow, shaded with light red, of good quality. Seems to be a shy bearer.

Hortense.—Large, handsomely colored, of best quality. An old variety which proves unproductive here.

Magnifique.—An old, late ripening French cherry, of good quality and attractive appearance. Quite productive.

May Duke.—Ripens early and lasts over a long season. Of value for home planting, but not profitable for market. Lacks productiveness.

Montrueil. Received from Stark Bros. in 1891. Seems to be but little known. Here it proves to be the most productive variety of its class on trial. The tree is a fairly vigorous, upright, spreading grower. Fruit above medium in size, dark red, of very good quality. Valuable for dessert and culinary purposes, and profitable for market. Ripens its fruit over quite a long season.

Rupp.—Received from the Division of Pomology, Washington, D. C., in 1894. Said to have originated in Pennsylvania. Cannot be distinguished from Hortense as grown here.

HEARTS AND BIGARREAUS.

Badacsony.—Tree only moderately vigorous with foliage quite subject to the attack of shot-hole fungus. Fruit red, mottled with purple, large and of good quality.

Baltavar.—Resembles Napoleon in shape and size, but in color is a little darker. The tree is vigorous, spreading, inclined to droop a little. Ripens with Napoleon. The most promising of three Hungarian varieties, Badacsony, Baltavar and Mednyansky, received in scion from the Division of Pomology in 1894.

Cleveland.—A very strong, spreading grower and quite an abundant bearer. Fruit large, light yellow, shaded with red. Ripens a few days earlier than Spanish.

Downer.—A handsome red cherry of medium size and good quality. A good late variety for home use.

Black Eagle.—A good grower, but not very productive. Fruit black, tender, of best quality.

Early Purple.—The first variety to ripen. Of value for home planting.

Ida.—A large, light colored cherry of very good quality. The tree is a good grower and a very abundant bearer. Valuable for home planting, but almost too tender for market purposes. Ripens with Gov. Wood, which variety it exceeds in size and productiveness.

La Maurie.—A few days later than Early Purple. The fruit is quite small and of a dark purplish color, almost black. Not desirable.

Mary Kirtland.—A very handsome, firm-fleshed variety, ripening with Gov. Wood. A regular bearer and a good variety for home planting.

Mednyansky.—Origin Hungary. Tree a moderately vigorous spreading grower, with large drooping leaves. The fruit is medium to large, black, of good quality. Ripe July 4.

Napoleon.—Very large, handsomely colored, of good quality. The tree is a good grower and a regular bearer. Valuable both for home use and market.

Plymouth Rock.—Size medium; color light yellow, shaded with red; quality good. Follows Gov. Wood closely in time of ripening. A new variety requiring further trial.

Purity.—A seedling of the Elton raised in California. Fruit amber, delicately shaded with red. Too delicate in texture for market purposes.

Schmidt.—A very large, late, dark colored cherry introduced from Germany. A very shy bearer here.

Yellow Spanish.—Well known. One of the best of the sweet cherries. Fruit large, heart shaped; color whitish yellow, shaded with red; quality very good.

Tartarian.—Large, black, of best quality. Tree a fairly vigorous grower and an abundant bearer. One of the most profitable market varieties.

Windsor.—Tree vigorous and good cropper. Fruit large, heart-shaped; color dark red; quality very good. Introduced from Canada a few years since and is now recognized as a very valuable cherry for market.

Wood.—One of the best early varieties. Fruit medium in size; color yellow, shaded with red; texture tender; quality very good. Valuable for home planting.

PEACHES.

The past season has been very favorable for the peach, except for the occurrence of heavy and long continued rains in midsummer, which caused the early varieties to rot badly. The number of bearing trees on the station grounds was considerably reduced last spring by the removal of quite a large number of varieties which had been sufficiently tested or which were too badly winter-killed to be longer useful. In all one hundred and fifteen varieties fruited during the season.

NEW VARIETIES.

Connett (Southern Early), Crothers, Longhurst, Oceana and Triumph are among the most promising new varieties fruited this season. Connett is a white peach of the Elberta type, ripening with Lewis. It is a larger, finer looking peach than Lewis, and is quite free from rot. Crothers is an attractive white peach, ripening the last of September. Longhurst is of the Chili type. It is somewhat superior to Chili as grown here. Oceana is a large yellow peach ripening about the middle of September. Triumph is one of the first yellow peaches to ripen. It has been widely planted and is now quite well known.

Sneed and Greensboro seem to have few characteristics likely to commend them to fruit growers of this State. Both are white peaches. Sneed was the first variety to ripen on the grounds this season. Greensboro came in with Triumph.

There seems to be a growing tendency in the Michigan peach belt at the present time toward the planting of yellow peaches to the exclusion largely of the white kinds. This precludes, to a great extent, the possibility of any of the newer white varieties becoming widely popular unless coming at a season when there are no good yellow varieties ripening. The open city market gets the bulk of the white fruit now grown. Buyers much prefer yellow fruit and special orders sent direct from consumer or dealer to the orchardist usually call for yellow peaches. This preference for yellow varieties doubtless comes about largely through the fact that, as a rule, yellow peaches handle better than white ones, arriving at their destination freer from discoloration and in better condition generally. No doubt the advent of the mechanical grader, which subjects the fruit to more severe handling than grading by hand, will further enhance this preference for yellow varieties.

TABULATION OF PEACHES, 1900.

Abbreviations: Form—c, compressed; o, oblate; ov, oval; r, round. Color—c, creamy; g, green; r, red; w, white; y, yellow. Adhesion—c, cling; f, free; s, semi-cling. Quality—1 to 10 — 1, very poor; 10, best. Flowers—l, large; m, medium; s, small. Glands—g, globose; r, reniform.

Name.	Planted.	Bloom.		Glands.	Ripe.	Adhesion.	Wt. of specimen in ozs.	Product (1-10).	Form.	Color.		Quality (1-10).
		Date.	Size.							Skin.	Flesh.	
Adrian	1892	May 12	s	g	Oct. 4	f	4	1	r ov	r y	y	6
Albright	1890	“ 12	s	g	“ 4	f	6	2	r	w	w	5
Alexander	1896	“ 12	l	g	July 30	c	5	4	r c	r g w	w	4
Allen	1890	“ 12	s	r	Sept. 15	f	4.8	2	r	y r	y	7
American Apricot	1892	“ 12	l	r	“ 25	f	3.2	10	r	y r	y	7
Amsden	1890	“ 12	l	g	July 26	c	4.15	1	r	r g y	w	4
Arctic	1894	“ 10	l	r	Oct. 4	f	3.6	2	r ov	g y	y	3
Barber	1894	“ 10	l	g	Sept. 25	f	3	1	r ov	r y	y	7
Bequette	1890	“ 12	m	r	“ 17	f	6.4	10	o	w r	w	5
Berenice	1894	“ 12	s	r	“ 25	f	5.6	10	o v	y	y	7
Bickell	1890	“ 12	m	r	Oct. 20	f	3.8	10	o v	w r	w	4
Bishop	1890	“ 12	m	g	Aug. 27	f	5.2	10	r	w r	w	8
Bokara (No. 3)	1896	“ 10	m	r	Sept. 3	f	2.8	1	r	w r	w	6
Bonanza	1890	“ 12	s	r	Oct. 20	f	3.8	10	o v	w r	w	5
Brigdon	1892	“ 12	s	g	Sept. 11	f	4.6	2	r ov	y r	y	7
Briggs	1890	“ 12	s	g	“ 8	f	3.8	1	r o	y r	y	8
Brunson	1894	“ 10	m	r	“ 18	f	3.2	10	r ov	y r	y	7
Brown	1892	“ 9	l	r	Aug. 21	f	3.4	10	r c	w r	w	6
Champion	1894	“ 12	s	g	Sept. 8	f	7.4	2	r	w r	w	10
Champion (Serrate)	1890	“ 12	l	....	July 27	c	3.2	9	r	c w r	w	5
Columbia	1890	“ 12	l	r	Oct. 4	f	4.4	3	r ov	r y	y	2
Connecticut	1896	“ 12	s	r	Sept. 15	f	2.7	1	r c	y r	y	7
Connett	1894	“ 10	l	r	Aug. 27	s	5.4	10	r ov	r w	w	7
Coolidge	1892	“ 12	s	g	Sept. 27	f	5.4	6	r ov	r y	y	7
Corner	1890	“ 12	s	r	“ 20	f	5	4	ov	y r	y	6
Crosby	1892	“ 12	m	r	“ 26	f	3.6	10	r o	y r	y	7
Crothers	1890	“ 12	s	g	“ 29	f	5.4	10	r ov	w r	w	7
Dennis	1890	“ 10	l	g	“ 14	f	3.4	10	r	y	y	7
Diamond	1892	“ 12	s	g	“ 26	c	4.4	1	r ov	y r	y	5
Druid Hill	1890	“ 12	s	g	Oct. 4	f	4.8	1	r	c w	w	8
Ede	1890	“ 10	m	r	Sept. 15	f	3.8	10	ov	y r	y	6
Engle	1892	“ 12	m	g	“ 10	f	4.4	10	r ov	y r	y	9
Ford New	1894	“ 12	m	g	“ 11	f	4.8	10	r	y r	y	7
Ford Red	1894	“ 10	s	r	“ 11	f	4.5	10	ov	w r	w	6
Ford 1	1894	“ 9	l	r	Aug. 23	s	5.6	10	r ov	w r	w	7
Ford 3	1894	“ 12	s	r	Oct. 1	s	4.2	7	r ov	w r	w	5
Foster	1893	“ 12	s	g	Sept. 11	f	5.2	2	r ov	y r	y	8
Gold Drop	1890	“ 10	l	r	Oct. 4	f	4.6	10	r	y	y	8
Grant	1890	“ 12	s	r	“ 4	c	5.6	1	r	c w r	w	6
Great Western	1893	“ 12	s	r	“ 20	c	5.6	1	r ov	w	w	4
Greensboro	1896	....	m	r	Aug. 13	s	4.2	10	r ov	w r	w	6
Haas	1890	May 12	l	r	“ 23	f	5	7	r	w r	w	5
Husted 101	1895	“ 12	s	r	Sept. 14	f	3.7	10	ov	y r	y	7
Infant Wonder	1892	“ 10	m	g	“ 11	f	3.8	10	ov	w r	w	3
Iron Mountain	1895	“ 12	s	r	Oct. 15	f	......	8	ov	w	w	2
Jacques Late	1890	“ 12	s	g	“ 1	f	4.7	4	r	c w r	c w	7
Jersey Yellow	1895	“ 12	s	r	“ 20	f	5.3	1	r ov	y r	y	4
June Rose	1894	“ 9	l	g	Sept. 11	f	5.4	10	ov	w r	w	5
Juno	1894	“ 12	l	r	Oct. 13	c	5.4	1	r	y r	y	5
Kalamazoo	1890	“ 12	m	r	Sept. 15	f	5	10	r ov	y r	y	8
Kallola	1892	“ 10	l	r	“ 24	f	3.2	10	r ov	g w	w	3
La Fayette	1897	“ 10	s	g	Oct. 4	f	3.5	10	r ov	y r	y	7
La Fleur	1894	“ 12	l	r	Sept. 26	f	3.8	6	ov	y r	y	5
Lemon Free	1894	“ 12	l	r	Oct. 10	f	6.8	10	r	y g	y	6
Lewis	1890	“ 12	l	g	Aug. 27	f	3.8	10	r	r w	w	6
Lock Cling	1892	“ 12	s	r	Oct. 20	c	4.2	1	r ov	w	w	4
Longhurst	1894	“ 12	l	r	Sept. 26	f	4.6	9	ov	r y	y	8
Lorentz	1895	“ 12	s	r	Oct. 20	f	4.8	4	r ov	y r	y	7
Lovell	1892	“ 12	s	g	Sept. 25	f	5.9	1	r o	r y	y	8
Lovett (white)	1890	“ 12	s	r	Oct. 12	f	3.9	10	r ov	c w	w	6

TABULATION OF PEACHES.—CONCLUDED.

Name.	Planted.	Bloom.		Glands.	Ripe.	Adhesion.	Wt. of specimen in ozs.	Product (1-10).	Form.	Color.		Quality (1-10).
		Date.	Size.							Skin.	Flesh.	
Magdala	1890	May 12	m	r	Sept. 3	f	3.4	5	r	w r	w	8
McCollister	1892	" 9	s	r	" 26	f	7.2	10	r ov	y r	y	6
McKevitt	1894	" 12	s	g	Oct. 4	c	5.7	1	r ov	c w	c w	4
Milhizer	1892	" 12	s	g	" 20	f	5.6	1	r	c w	w	5
Morris Co.	1890	" 12	s	r	" 17	f	5	1	r ov	c w	w	4
Muir	1890	" 12	s	r	Sept. 24	f	7.4	4	r ov	y r	y	7
Neil	1892	" 9	l	r	Oct. 9	f	5	6	ov	y	y	7
New Prolific	1894	" 12	m	r	Sept. 15	f	4	4	r ov	y r	y	7
Normand	1892	" 12	s	r	Oct. 13	c	5.4	1	r ov	c w	c w	5
Oceana (Husted 130)	1895	" 10	m	r	Sept. 11	f	4.2	10	r ov	y r	y	7
Oriole	1894	" 10	l	r	" 25	c	4.8	10	r ov	y r	y	5
Ostrander	1892	" 12	s	g	Aug. 27	s	7.5	1	r	y r	y	6
Pallas	1894	" 12	l	g	Sept. 4	f	2.7	10	r ov	g w r	w	7
Palmerston	1890	" 12	s	g	" 29	c	7.8	1	r ov	w	w	7
Peninsula	1894	" 12	s	g	" 27	f	4.2	1	r ov	y r	y	5
Pickett	1890	" 12	s	r	" 29	c	5.2	5	r ov	y r	y	5
Princess	1894	" 12	l	g	" 25	f	6.7	1	r ov	c w r	c w	8
Prize	1892	" 12	s	g	Oct. 1	f	6	2	r ov	y r	y	6
Prize 1	1890	" 12	s	g	" 1	f	5	1	r ov	y r	y	6
Red Cheek	1893	" 12	s	g	Sept. 26	f	4.4	6	r ov	y r	y	5
Reid	1890	" 12	s	g	" 8	f	6.5	1	r ov	y r	y	8
Rivers (Ey.)	1890	" 10	l	r	Aug. 16	s	4.5	10	r ov	w r	w	5
Roser	1892	" 10	l	r	Oct. 13	f	2.8	10	r ov	c w	w	2
R. S. Stevens	1891	" 12	s	r	Sept. 11	f	4.4	7	r ov	y r	y	8
Salway	1890	" 12	s	r	Oct. 20	f	5.9	10	r	y r	y	8
Scott	1890	" 12	s	g	Sept. 29	f	5.2	8	r	y r	y	7
Shipley	1890	" 12	s	g	" 22	f	4.8	1	r ov	y r	y	6
Smock	1890	" 12	s	r	Oct. 9	f	5.2	10	ov	y r	y	6
Smock X	1892	" 12	s	r	" 4	f	5	6	r ov	y r	y	6
Smock (Hance)	1890	" 12	s	r	" 17	f	4.8	1	ov	y r	y	6
Sneed	1896	" 9	l	r	July 23	s	2.3	4	r ov	r w g	w	4
Spotswood	1894	" 12	l	r	Sept. 25	f	5.1	8	r ov	c w	w	5
Stark Heath	1892	" 12	s	r	Oct. 13	c	6	8	r ov	c w	w	3
Stevens Late	1890	" 12	s	r	" 4	f	6	2	ov	w r	w	6
Stevens R. R.	1890	" 12	s	r	Sept. 26	f	7.2	6	r ov	w r	w	7
St. John	1890	" 12	s	g	Aug. 27	f	6	5	r	y r	y	8
Strong (Mam.)	1892	" 12	s	g	Sept. 25	f	4.4	2	r	c w	w	6
Stump	1890	" 12	s	g	" 26	f	5	7	r ov	r w	w	6
Summer Snow	1894	" 10	l	r	" 26	c	1.8	10	r	w	w	2
Surpasse	1890	" 12	s	r	" 4	f	4	1	r	y r	y	8
Switzerland	1890	" 12	s	g	Sept, 22	f	4 4	4	r	c w	w	7
Tallman	1896	" 10	l	r	Aug. 15	s	3.2	1	r c	c w r	w	5
Toquin	1892	" 12	l	r	Sept. 25	f	3.6	8	ro	y r	y	8
Townsend	1892	" 12	s	g	" 29	f	6.3	1	r.	y	y	6
Triumph	1896	" 10	l	g	Aug. 13	s	3.8	10	r	y r	y	6
Troth	1890	" 12	s	g	" 28	f	3	8	r	w r	w	8
Tuskena	1890	" 12	m	r	Sept. 29	c	7.4	1	r ov	y r	y	8
Walker (Var.)	1890	" 12	s	g	Oct. 4	f	5	3	r ov	c w r	w	7
Washington	1890	" 12	s	g	Sept. 22	f	5.6	4	r ov	r w	w	7
Willett	1894	" 10	l	r	" 24	f	4.2	10	ov c	y r	y	8
Williamson	1892	" 12	s	g	Oct. 4	f	5.8	1	r ov	y r	y	6
Wonderful	1890	" 12	s	r	" 9	f	5.7	1	ov	y r	y	5
Worthen	1890	" 12	s	r	Sept. 11	f	4.4	9	r ov	y r	y	8

SPRAYING.

Spraying in early spring with copper sulphate, one pound to twenty gallons of water, again proved an effectual preventive of leaf curl. Trees and parts of trees left unsprayed curled badly, while sprayed trees were very little, if any, affected. As in former tests, early spring spraying gave much better results than when the spraying was done just before the fruit buds opened. Spraying with Bordeaux mixture and paris green after the fruit had set, had no effect upon the leaf curl, but was effective against the curculio and shot hole fungus. As the foliage of the peach is very tender, care should be taken to have the spraying mixture properly prepared, and somewhat weaker than is used for other fruits.

The need of thoroughness in spraying cannot be too strongly emphasized. If the spray does not come in contact with all parts of the tree the curl is sure to appear when conditions are at all favorable for the disease. Twigs and branches with leaves badly curled can often be seen in early summer in sprayed orchards, showing that the work has not been thoroughly done. Last spring a row of trees on the station grounds, which could only be sprayed from one side, because of the proximity to a fence, curled badly on the opposite side from which the spraying was done. To be effectual spraying must always be done from both sides of the tree row.

PRUNING.

In last year's report (Bulletin No. 177) details of an experiment in pruning frost-injured trees was given. In this report it was stated that in the light of last season's experience, very severe pruning proved dangerous to the life of the tree, but more moderate pruning or cutting back upon wood from one-half to three-fourths of an inch in diameter gave better results than pruning in the usual way. Observations extending over another season confirm the belief that much risk is incurred in cutting the main branches of the tree back to stubs, and at the same time strengthen the opinion that a moderately severe pruning is highly beneficial. Trees given the latter treatment have grown vigorously, developing clean, new, thrifty tops and this season were covered with healthful, dark green foliage, and were for the most part loaded with attractive fruit of fine quality. On the other hand trees which were pruned lightly after the usual plan of heading in and thinning out part of the new growth have grown more slowly, were marked by smaller, less thrifty foliage, bore fruit of smaller size and poorer quality, and this fall contain much more dead wood.

But it must be admitted that no manner of pruning will entirely renovate a badly frozen tree. There is hardly a tree above four years old on the station grounds that is not rotten in trunk and main branches and is held together only by the new growth which has been made since the freeze. This being the case the trees broke down badly in winds and under their weight of fruit this season. But trees well cut back, having made a greater development of new wood, were better able to resist influences which tended to break them down, and doubtless their lives will be considerably prolonged.

THINNING.

Tests of thinning to varying degrees gave results this season favoring much more severe thinning than is commonly practiced. A distance of ten inches between fruits seemed to be none too great in the case of a number of the varieties experimented on. When the fruit ripened the trees were found to be carrying full loads, and in no instance did the thinning seem to be overdone.

Trees purposely left without thinning were broken down more or less by winds and by the weight of the crop, and the fruit was so small as to be almost unsalable.

The danger of thininng too severely is practically nil, since one rarely, if ever, thins to so great an extent as he purposes. Fruits, and even whole clusters of fruit, are overlooked owing to their small size at the time of thinning, and the obscuring effect of the foliage. Indeed, so true is this in the case of varieties particularly inclined to overbear, that a second thinning after the fruit has become larger is often desirable, if not positively necessary, to reduce the crop to the proper limit.

NOTES ON VARIETIES.

Allen.—A roundish, smooth, yellow, free stone peach of large size and good quality. Ripe September 15. Quite unproductive.

American Apricot Peach.—Inclined to be undersized even when well thinned. Resembles Gold Drop in appearance, but is not of so good quality. Ripe in late September.

Arctic.—Slow to bear and quite unproductive. The fruit is of medium size, greenish yellow, dry fleshed, and of rather poor quality.

Bequette Free.—A very large white peach of the Elberta type. Has made a good record here, but ripening as it does with Elberta, the latter is preferred since it is yellow-fleshed.

Berenice.—A pale yellow peach of fair size and good quality, but of rather poor appearance. Ripe September 25.

Bickell.—Late, white, of poor quality, freestone. Ripens with Salway.

Bokara No. 3.—Both a white and a yellow peach are out under this name. The following statement from Prof. J. L. Budd, the originator of this variety, was kindly sent to this station by Wm. A. Taylor, assistant U. S. Pomologist: "Some of the seedlings we grew from pits of Bokara have white flesh, but Bokara No. 3 has yellow flesh, with red next the pit. The nursery evidently mixed them." The station trees fruited for the first time this season, bearing white fruit. Since they prove to be spurious an effort will be made to procure and test the true variety at as early a date as possible.

Brunson.—Very closely resembles Kalamazoo, although of distinct origin.

Brown.—New, from Berrien county. Nearly the entire crop rotted this season. Very similar to Lewis, but fruited a little better than Lewis last year.

Champion.—Very large, handsomely colored, of best quality. Several specimens weighed from twelve to thirteen and one-half ounces, and measured from ten and one-half to eleven and one-half inches in circumference. Too tender to ship well. Makes few fruit buds and is inclined to be a shy bearer. Ripens with Engle Mammoth.

Connecticut.—A moderate grower and thus far productive. Fruit medium sized, yellow, of good quality. Here it has not proven extra hardy, as claimed.

Connett (Southern Early).—A large, handsome, white peach of the North China or Elberta class. One of the best early varieties. Ripens with Lewis and is a larger peach. Not so hardy as Lewis, but entirely free from rot, while the whole crop of Lewis rotted this season. Promising for early market.

Crosby.—Not so hardy as has been claimed and the fruit is inclined to be small in spite of severe thinning. Ripens about a week earlier than Chili. Fruit round, yellow, free.

Crothers.—"Originated on the farm of Mr. Crothers, near Neosho Falls, Kansas." (H. E. Van Deman, in R. N. Y., Sept. 15, 1900.) A medium to large white peach with red cheek, firm and of good quality. Has proven an abundant bearer here. Ripens just before Gold Drop.

Ede (Capt.)—Resembles Elberta in shape, color and flavor, but is not so large. Ripens several days earlier than Elberta. Very subject to leaf curl.

Engle Mammoth.—Large, roundish, yellow, of very attractive appearance and fine quality. Very productive and one of the most valuable market varieties grown. Season middle of September.

Ford, New.—A large yellow peach of good quality. Ripens with Engle Mammoth and does not appear very different from that variety.

Ford 1.—A large, white freestone, ripening a few days earlier than Lewis. Larger and more attractive than Lewis. Quite free from rot. Bore heavily this season and deserves further trial.

Ford 3.—Almost too late for this climate, not fully ripe October 25. Fruit large, white, of rather poor quality.

Ford Red.—An oval-shaped white peach ripening in early September. Resembles Ford 1, but ripens a number of days later.

Foster.—Large, yellow, of the Crawford type. A handsome variety of good quality, but unfortunately it is tender in bud and a shy bearer.

Gold Drop.—Hardy and productive to a fault. When severely thinned it is one of the most profitable late market kinds. Round golden yellow, of good quality. Season late September and early October.

Greensboro.—A new peach from Greensboro, N. C. In color it is creamy white, delicately blushed with light red. Shaped like Elberta and is about two-thirds the size of that variety. Ripened three days earlier than Early Rivers, fourteen days later than Alexander, and right in the season of the Triumph. It is almost as tender in flesh as Early Rivers and will require very careful handling. Does not seem very promising for the North.

Husted 101.—A medium to large peach resembling Chili strongly in appearance, but ripens two weeks earlier. Quality very good. Bore heavily this season.

Ice Mountain.—Too late for this climate. The fruit, still green and hard, was frozen on the trees this fall about the middle of November.

Iron Mountain.—A few days later than Salway. Large, white, of low quality. No good here.

Jersey Yellow.—An oval-shaped yellow peach resembling Wonderful, but is ten days later. Inclined to be unproductive and is not considered promising.

June Rose.—A showy, white peach of rather tender texture ripening in early September. Usually quite productive and of good quality.

Kalamazoo.—Hardy and very productive. Fruit medium to large, yellow, usually with red cheek. One of the most profitable market varieties grown in Michigan. Season middle of September.

Kallola.—A creamy white peach of large size and good appearance, but of low quality. Ripens in late September. Not valuable.

La Fayette.—Trees received from C. Engle, Paw Paw, Mich. The fruit closely resembles Crosby, but the leaf glands are globose, while those of Crosby are reniform. Requires further trial.

Lemon Free.—A large, greenish yellow peach, ripening about with Smock. Although not very attractive in appearance, the quality of the fruit is good and the trees are productive. Seems to possess a fair degree of hardiness, as it was one of the forty-seven varieties to fruit after the freeze of 1898-9. Promising for late market.

Lewis.—A well known Michigan seedling. Hardy and very productive. Of medium size, white, fair quality. The fruit all rotted this season.

Longhurst. This variety is of the Chili type and ripens in the season of the Chili. It seems to be an improvement over the latter, being smoother, larger and more highly colored.

Lorentz.—A large, yellow, oval-shaped peach of good quality, ripening with Salway. Less than half a crop this season on five-year-old trees.

Muir.—A California seedling reported to be one of the best originated in that state. Here it proves to be a shy bearer. The fruit is of largest size, yellow with a dull red cheek; of quite good quality. Ripens in late September.

New Prolific.—A medium to large yellow peach of good quality. Ripens with Kalamazoo. In fruit resembles that variety.

Oceana (Husted 130).—A promising new variety, ripening in early September. The fruit is large, yellow, with red cheek, free, of very good quality. Bore a full crop this season and has usually been productive.

Ostrander.—Of large size, yellow well shaded with red. Ripens late in August. Lacks hardiness and productiveness.

Pallas.—Of the South China race; origin Georgia. Color white with red blush; form oval with pointed apex; size medium; quality fair to good. Season early September. Not considered very desirable.

Pickett.—A medium sized yellow cling, ripening in late September. No good here.

Princess.—Of largest size, white, free; tender in bud, unproductive.

Prize.—Strongly resembles Late Crawford and is no more productive than that variety. Received from Stark Bros. in 1892.

Prize 1.—Also received from Stark Bros. Cannot be distinguished from Prize.

Red Cheek.—Of large size, roundish; color yellow with bright red cheek; season last of September. Curls badly. Planted to some extent for market, and is well spoken of by some of the growers of this section.

Rivers.—An old variety found in many of the Michigan orchards, but no longer planted to any extent. White, very tender, of fair quality.

Roser.—Received from I. E. Ilgenfritz, Monroe, Mich., in 1892. A late white freestone of poor quality. Ripens with Smock. Not valuable.

Salway.—Unquestionably the best peach for October. Large, round, yellow with red cheek, fair to very good quality, depending on the season. Fairly hardy and usually productive. Rather late for this climate.

Shipley.—Quite unproductive. The fruit is large, yellow, with red cheek, of fair quality. Ripens in late September.

Smock.—An old variety well known and much esteemed for late market. Color greenish yellow, with a slight red blush on exposed surface; quality quite good, but inclined to be a little sour. Wood brittle, easily broken by winds. Quite free from curl.

Smock, X.—Ripens a few days in advance of Smock, but otherwise is not different.

Smock, Beers.—Cannot be distinguished from Smock on the station grounds.

Smock, Hance.—Does not differ from Smock here.

Sneed.—Originated by J. L. T. Sneed, of Tennessee. Tree a good grower with large, long, light green leaves. Glands reniform. Size of fruit small to medium; form roundish oval; color creamy white, shaded with light red; flesh tender, juicy, of fair quality; semi-cling. Ripened this season six days earlier than Alexander. This variety lengthens out the peach season by several days, but aside from earliness it has little to recommend it.

Spottswood.—Color greenish white, rather unattractive. Ripens last of September. Not very desirable.

Stark Heath.—A large white cling of fair quality, ripening about the middle of October. Strongly resembles Heath Cling.

Stevens Rareripe.—Size medium to large, roundish ovate; color creamy white with red cheek; flavor vinous and sprightly; season middle to late September. A profitable market variety in some sections.

St. John.—Does not make many fruit buds and hence sometimes fruits rather sparsely. However, it is usually considered quite profitable for market since it is one of the earliest yellow peaches.

Stump.—An old white variety no longer planted by Michigan peach growers. The trees are inclined to be unproductive and the fruit is tender for shipment. Season late September.

Summer Snow.—A small white cling of low quality, ripening in late September. Worthless.

Surpasse.—Received from Ellwanger and Barry in 1890. A large, handsome, yellow peach of fine quality, ripening in early September. A shy bearer.

Switzerland.—A medium to large, white freestone, ripening in late September. Differs but little from Stevens Rareripe. Has proven fairly productive, and in some sections has been grown with considerable profit for market.

Tallman.—Buds of this variety were received from H. B. Tallman, Tecumseh, Mich. in 1894. Proves to be a small white peach of good quality, ripening with Triumph. Not valuable.

Triumph.—This new peach fruited in a great many orchards of the State during the past season and has generally been well spoken of, although in some instances complaints of small size have been made. In the market it sold better as a rule than the white-fleshed varieties of its season. It ripens about two weeks later than Alexander, and for its season bids fair to prove the best variety grown unless superseded by Dewey, for which strong claims are made. The tree is an upright spreading grower, vigorous, hardy, productive, and an early bearer. Size of fruit medium, or a little above, roundish; color yellow, well overlaid and blotched with dull dark red; flesh sweet, melting, juicy, quite good; semi-cling. Rotted badly this season, but not to quite so great an extent as some of the early white varieties. The principal faults of this variety are dull color, tendency to cling considerably, susceptibility to rot and leaf curl, and inclination to run small unless well thinned.

Tuskena.—A large, yellow-fleshed, handsomely colored clingstone, ripening the last of September.

Wonderful.—Large, yellow, roundish oval, of good quality. Ripens in early October. Unproductive.

PEARS.

More than two-thirds of the late pears were blown off by a high windstorm September 11 and 12. In recording the productiveness of the various kinds when the fruit ripened, some allowance was made for the effects of this storm and the figures given in the accompanying tabulation are intended to represent the original crop upon the trees.

TABULATION OF PEARS, 1900.

Abbreviations: Season—e, early; m, middle; l, late. Form—e, elongated; i, irregular; o, oblate; ob, oblong; obo, obovate; obt, obtuse; ov, ovate; p, pyriform; r, round; t, turbinate. Color—b, brown; c, crimson; g, greenish; r, red; ru, russet; w, whitish; y, yellow. Texture—b, buttery; f, firm; g, granular; m, melting; t, tender; br, breaking. Flavor—a, acid; m, mild; as, astringent; j, juicy; s, sweet; v, vinous; p, perfumed. Use—d, dessert; k, kitchen; m, market.

Name.	Planted.	Bloom.	Season.	Vigor.	Product.	Weight in oz.	Form.	Color.		Texture.	Flavor.	Quality.	Use.
								Skin.	Flesh.				
Angouleme	1891	May 12	Oct. Nov.	10	10	8	ob obo	y	w	b	m v	8	d m
Anjou	1888	" 12	l Oct.	9	1	7.8	obt p	y g r	w	m	v p	9	d m
Ansault	1889	" 14	e Oct.	7	10	4.8	obo p	y ru	w	t b m	v	8	m
Bartlett	1891	" 14	m Sept.	9	9	4.6	obt p	y r	w	t b m	v	7	d m
Bloodgood	1888	" 14	m Aug.	10	7	3.2	t obo	y ru	w	b m	s p	8	d
Bosc	1888	" 14	Oct.	10	1	6.2	p	y ru	w	m b	s j p	10	d m
Boussock	1891	" 14	m Sept.	10	1	6.6	r obo	y ru	w	b m	s j p	6	m
Clapp	1888	" 14	m Aug.	10	10	9	t	y r	w	b m	v	7	d m
Dana Hovey	1888	" 14	Oct. Nov.	9	8	2	obo obt p	y ru	w	g m	s p	10	d
Dearborn	1891	" 15	Aug.	6	5	1	r p	y	w	m	s	4	d
Desportes	1891	" 13	e Aug.	6	1	3.2	p	g y	w	m	s	5	....
Drouard	1890	" 15	Nov.	9	3	4.2	obt p	y ru	w	t b m	s p	5	m
Early Duchess	1892	" 14	m Sept.	8	3	5.7	obo p	y r	w	t b m	v	7	m
Elizabeth	1891	" 13	l Aug.	10	10	3	r obo	y r	w	b	s p	8	d
Esperen	1891	" 13	Oct.	10	3	2.8	r obt p	y ru	w	t g m	v	5	....
Fitzwater	1891	" 14	Oct.	7	1	4.4	obo p	y ru	w	b m	s	9	d m
Flemish	1891	" 13	l Sept.	10	10	9	obo obt p	y ru r	w	m	s j	7	d m
Fred Clapp	1888	" 14	l Sept. Oct.	10	1	3.6	r obo p i	y	w	b m	v	8	d m
Gansel Seckel	1892	" 14	Oct.	8	1	4	r o i	y ru	w	m	s	7	....
Giffard	1888	" 13	e Aug.	8	10	3.9	p	g y r	w	m	j v p	9	d m
Howell	1888	" 14	l Sept.	7	10	7	r p	y r	w	m	v	6	m
Idaho	1893	" 14	Oct.	7	1	6.2	r o i	y ru	w	t	m v	6	....
Jones	1897	" 15	Oct. Nov.	8	1	2.6	obo p	y ru	w	g br	v	6	d
Kieffer	1891	" 15	Nov. Dec.	10	8	5.1	r ov obt p	y r	w	f b	s v	4	m
Kentucky	1891	" 14	m Sept.	10	5	2.5	t	y	w	c b g	v	3	....
Kraus 41	1893	" 14	l Aug.	6	1	3.4	p	y r	w	f	s	3	....
Lawrence	1888	" 13	Oct. Dec.	7	7	3.6	obo obt p	y	w	m	s p	9	d m
Lawson	1889	" 14	e Aug.	9	2	6.2	obo p	y r	w	br	s	3	m
Longworth	1891	" 15	Sept. Oct.	10	10	4.8	obo t	y	w	f g	s	5	....
Lucrative	1888	" 12	m Sept.	9	3	3.3	obo p	y	w	m	s	9	d
Marguerite	1889	" 14	l Aug.	9	10	3.8	p obt	g y	w	b	v	8	d
Millett	1891	" 14	Nov. Dec.	8	9	4.2	obo obt p	y ru	w	f	v	5	....
Mount Vernon	1894	" 13	Oct. Nov.	10	10	5.2	r obt p	ru	w	t b m	j v p	7	m
Onondaga	1891	" 14	l Oct.	10	7	6.2	obo obt p	y	w	f g	v	5	m
Pitmaston	1891	" 14	e Oct.	10	3	10.6	ob obo p	y ru	w	m b	v p	6	m
Reeder	1891	" 14	Oct.	9	1	4	obt p	y	w	b m	v	6	m
Rostiezer	1888	" 14	l Aug.	10	10	2.2	obo p	y ru	w	b m	s v	10	d
Rutter	1892	" 14	Oct.	10	5	6.8	r p	y r	w	b m	s v	7	m d
Seckel	1888	" 14	Oct.	9	10	2.2	obo r p	y b ru	w	t b m	s b	10	m d
Sheldon	1890	" 14	Oct.	9	5	4.4	r obt obo	ru	w	m	s v	8	m d
Souvenir	1890	" 14	Oct.	8	4	6.6	obo p	y	w	t m	v	5	m
Sterling	1888	" 14	m Sept.	10	1	4.7	t	y r	w	m	s	5	m
Summer Beauty	1895	" 13	m Sept.	10	2	5.2	obo	y r	w	b	s	5	m
Summer Doyenne	1888	" 14	e Aug.	10	7	1.5	r obo	y b	w	t b m	s v p	5	d
Wilder	1889	" 14	m Aug.	10	1	4.2	obt p	y r	w	t	m	4	m
Winter Nelis	1888	" 14	Nov. Jan.	8	10	2.6	obo	y ru	w	t b m	s p	10	d m
Zache	1894	" 14	Nov. Apr.	10	10	7.8	r	y ru	w	g	m s	3	....

A comparative test of early spring spraying with copper sulphate, one pound to fifteen gallons of water, and late spraying with Bordeaux mixture just as the fruit buds were about to open, resulted this season in favor of the latter treatment. The Flemish Beauty, in particular, was observed to be almost entirely free from scab where given the late application of Bordeaux, while fruit of trees sprayed early with copper sulphate was considerably affected. The scab fungus is very apt to make its appearance in the blooming period, attacking the fruit stalks and causing the falling off of much of the young fruit. Bordeaux mixture applied after the flower buds are well formed, but before any have actually opened, not only prevents largely this attack upon the fruit stalks, but also keeps the fruit itself free from the disease.

Standard pear trees on the station grounds are often mistaken for dwarfs. This is because the trees are started low and headed-in each season, thus giving them a dwarfish appearance. Some of the advantages claimed for this system are: Greater ease in thinning, picking and spraying, and less liability of the fruit blowing down. About the only objection to low heading is that it makes the working of the ground in the orchard a little more difficult. But this objection is not a very serious one in the case of the pear, since the trees are usually quite upright in habit of growth and admit of close working with a horse, even when headed almost to the ground.

NOTES ON VARIETIES.

Angouleme.—One of the best late fall market varieties. Succeeds best as a dwarf. Of large size, oblong obovate; color greenish yellow; quality very good. Largely grown.

Anjou.—A fine fall pear, but a shy bearer while young. Twelve year old trees have fruited very sparsely as yet. Color yellow, often with a brownish red cheek; quality very good. October and November.

Ansault.—An early and abundant bearer. Ripens just before Sheldon and resembles that variety in general appearance.

Bartlett.—One of the most popular home and market pears grown. Fruits well here. Season early September.

Beauty (Summer).—A medium to large yellow pear of only fair quality. Rots at the core. Seems to have little to recommend it aside from vigor of tree. Follows Bartlett closely in time of ripening. Introduced by Otto Locke, of New Braunfels, Texas. The trees were received from the Division of Pomology in 1894.

Bloodgood.—A valuable dessert pear, ripening in August. Size medium, turbinate; color yellow, well covered with brownish russet; quality very good.

Bosc.—Size large, pyriform; color dark yellow, nearly covered with patches and dots of cinnamon russet; quality best. A valuable autumn variety for home or market.

Clapp Favorite.—Large, turbinate; yellow with brownish red cheek; quality quite good. A good grower and an abundant bearer, but the fruit is liable to rot at the core and should be picked before fully ripe. Quite subject to the attack of pear blight.

Dana Hovey.—Fruit rather small, obtuse pyriform; color yellow, russeted; quality best. Ripens in October and will keep a number of weeks. A valuable dessert variety.

Dearborn.—Size small, roundish, pyriform; color clear light yellow; quality rather low. Not very valuable. August.

Desportes.—Size medium or a little below; color greenish yellow, blotched and specked with russet; quality rather low. Inclined to rot at the core. Not valuable here.

Drouard.—Size large, roundish pyriform; color yellow, considerably russeted; quality good. Not very productive as yet, but otherwise promising for market. November.

Early Duchess.—Resembles Angouleme in shape and color, but has a smoother surface. Ripens three weeks earlier. Requires further trial.

Elizabeth (Manning).—Size small, roundish obovate; color yellow with bright red cheek; quality very good. The tree is a fine, shapely grower and an abundant bearer.

Esperen.—Fruit medium, or a little below, roundish obtuse pyriform; color light yellow, well covered with cinnamon russet; quality fair only. Blights badly here.

Fitzwater.—Size medium, obtuse pyriform; color yellow with tracings and blotches of cinnamon russet; quality good. Quite unproductive as yet. October.

Flemish (Beauty).—Very subject to the attack of scab fungus, but a fine, handsome pear when well grown. Size large, obtuse pyriform; color greenish yellow, somewhat russeted, and with a brownish red cheek; quality very good. Late September.

Gansel Seckel.—A medium sized, roundish oblate pear, yellow in color, overlaid with cinnamon russet, particularly toward the calyx end. The flesh is white, juicy, melting, somewhat granular; quality good, not rich and with none of the spicy flavor of the Seckel. The tree is an upright, spreading grower with a roundish head. Trees set in 1892 fruited this season for the first time.

Giffard.—A medium sized pear of good quality, ripening in August. In color the fruit is greenish yellow, sometimes with a dull red cheek. Valuable for home planting.

Howell.—A very smooth, roundish pyriform variety, of light yellow color with blush. Bears annually and abundantly. A good home and market variety. September and October.

Idaho.—A medium to large roundish oblate pear, yellowish with many russet dots and patches, and frequently with a reddish brown cheek. Not very attractive in appearance. Quality fair to good. The tree is strikingly like Bartlett in growth and color of wood. Blights badly. October.

Jones.—Size small, obovate pyriform; color yellow, russeted; quality good. Does not seem very promising.

Kieffer.—A standard variety largely planted at the present time and much used for canning purposes. The characteristics which commend it to the commercial grower are vigor, early maturity and productiveness of the tree, and firmness, good keeping qualities and fine appearance of the fruit. Although in no sense a dessert pear, it is fairly good for eating raw when well ripened, and for canning purposes it is regarded with much favor since it holds together well when cooked and develops a good flavor.

Kentucky.—A small, greenish yellow pear of poor quality, ripening in September. Worthless here.

Kraus 41.—Size medium, pyriform; color yellow; quality poor. Late August. Does not seem promising.

Lawrence.—A late fall and early winter variety. Color greenish yellow, slightly russeted; quality very good. Grown to some extent for market. October to December.

Lawson.—Large, yellow with red cheek; handsome but of low quality. Twelve year old trees have thus far fruited sparsely. Early September. Lasts but a short time.

Longworth.—An upright, vigorous grower. Fruit medium, obovate turbinate; color light waxen yellow with many small russet dots; quality poor; texture firm, breaking, coarse and granular. Not valuable.

Marguerite.—A medium sized, greenish yellow pear of good quality. Apt to rot at core if allowed to ripen on the tree. Valuable for home use. August.

Millett.—Size large, obtuse pyriform; color greenish yellow, blotched with russet; texture firm, breaking; quality fair only. Keeps all winter.

Mt. Vernon.—A medium sized, yellow russeted pear of fairly good quality. The trees are upright, vigorous growers and quite productive. Valuable for home or market. October and November.

Onondaga.—A large, yellow, slightly granular pear of fair to good quantity. Not very productive here. September to November.

Pitmaston (Duchess).—One of the largest varieties on trial. Shape oblong, obovate, remotely pyriform; color yellow with russet dots and specks over the whole surface; flavor sprightly, vinous. Being large and heavy this pear blows down badly, otherwise promising for market.

Reeder.—A smooth, fair growing pear, somewhat resembling Howell in appearance. The trees are young and unproductive as yet. October and early November.

Rostiezer.—Tree an open grower with stout, brownish shoots. The fruit is rather small, obovate pyriform; color dull, yellowish brown with reddish brown cheek. Not very inviting in appearance, but of the best quality. Early September.

Rutter.—Large, roundish pyriform; color yellow, dotted and netted with russet; flavor sweet, vinous. The tree is an upright, vigorous grower. Considered desirable either for home or market. October.

Seckel.—Well known. Grows well and fruits well here. Best for dessert purposes.

Sheldon.—A medium sized russeted pear of very good quality. Valuable for home use, but almost too tender and perishable for market. October.

Souvenir (du Congres).—Resembles Bartlett in appearance, but is considerably larger. Texture tender, melting; quality good. Ripens in early October.

Wilder.—Twelve year old trees are thus far lacking in productiveness. Fruit medium, obtuse pyriform to obovate; color yellow with light red cheek; quality fair to good. Upright and vigorous in growth. Ripe in early August.

Winter Nelis.—A crooked, poor grower and should be top worked on some straight-growing variety. The fruit is small, obovate; color yellow, more or less covered with specks and blotches of dark cinnamon russet; quality best; season October to January. One of the best winter varieties.

Zache.—A Chinese sand pear, roundish oblate in form and of large size. Color orange with many light yellowish dots and specks; quality poor; texture coarse, crisp. The tree is a fine strong grower with large, thick, glossy leaves. Keeps all winter. Not valuable.

QUINCES.

Variation among quinces is not nearly so great as in other kinds of tree fruits. It is restricted largely to differences in shape and size of the fruit. The new varieties of the Orange type on trial here differ but little from the Orange quince except in some instances for size.

The crop was good this season. Champion, Missouri and Rea were among the more productive varieties.

TABULATION OF QUINCES, 1900.

Name.	Planted.	Bloomed.	Ripe.
Alaska	1891	May 24	Middle of October.
Angers	1890		
Bourgeat	1895		
Champion	1888	May 25	Early November.
Fuller	1894	" 25	Middle of October.
Meech	1888	" 25	Middle of October.
Missouri	1891	" 24	Early October.
Rea	1888	" 24	Early October.
Van Deman	1895	" 25	Middle of October.

NOTES ON VARIETIES.

Alaska—Smaller than Orange, but otherwise not very different from that variety.

Champion.—Large, greenish yellow, firm, crisp, of good quality. An early and abundant bearer. October and November.

Meech.—Below medium in size, very symmetrical in form, slightly pear-shaped. Vigorous and very productive.

Missouri.—A very large quince of best quality. Somewhat irregular in form. Moderately productive. October.

Rea.—Vigorous and productive. A seedling of the Orange. It is a little larger and finer quince than its parent.

Van Deman.—Medium to large, clear, rich yellow. Seems to differ little from Orange.

PLUMS.

The plum crop this season was badly damaged by rot. Efforts to control this disease by spraying have proven rather unsatisfactory here. At the time when the rot usually does the most damage the plums are well grown and coated with bloom, which so effectually sheds the spray, that not enough remains on the fruit to act as a preventive, to any extent, against infection from the spores of the disease. Thinning does much good by leaving the fruits farther apart with less chance for the disease to spread from one fruit to another. The prompt removal of affected fruit is also a valuable aid in the control of the disease.

The native plums are, with slight exceptions, much inferior to the European and Japan kinds as grown in this climate, and nearly all except a few of the newer varieties recently introduced have been dropped from the station collection.

TABULATION OF PLUMS, 1900.

Abbreviations: Form—l, long; o, oval; ob, obovate; r, roundish. Color—b, black; g, greenish; p, purple; r, red; w, whitish; y, yellowish. Adhesion—c, cling; f, free; s, semi-cling.

Name.	Species.	Planted.	Vigor.	Bloom.	Ripe.	Form.	Color.	Adhesion.	Weight of specimen in ounces.	Product.	Quality.
Abundance	Triflora	1895	10	May 9	Aug. 14	r o	y r	c	1.1	10	8
Agen Prune	Domestica	1890	10	" 9	Sept. 7	o	p	f	.7	8	8
Arch Duke	Domestica	1893	9	" 12	" 20	r o	b	f	1.3	1	7
Aubert	Domestica	1888	9	" 12	" 8	o	y	c	1.8	7	5
Baker (Damson)	Domestica	1893	8	" 12	" 11	r	b	s	.25	1	6
Bavay	Domestica	1890	8	" 9	" 30	r	y	c	1.6	6	10
Babcock	Triflora	1897	8	" 12	" 13	r o	y p r	c	1.6	1	6
Bradshaw	Domestica	1890	9	" 14	Aug. 27	o	r p	f	1.8	5	6
Burbank	Triflora	1893	10	" 9	" 27	r	y r	c	1.4	10	6
Burbank No. 7	Domestica	1890	8	" 9	Sept. 18	r ob	g y	f	1.5	2	9
Chase	Triflora	1890	9	" 12	Aug. 28	r o	y r	c	1.6	10	6
Coe	Domestica	1893	8	" 9	Sept. 23	o	g y	c	2.2	1	8
Columbia	Domestica	1892	8	" 12	" 5	r	p	f	2	1	7
Diamond	Domestica	1892	9	" 11	" 1	o	b	f	1.1	3	5
Early Red	Domestica	1890	6	" 12	" 4	o	r	c	1	1	7
Engle	Domestica	1890	7	" 9	Aug. 24	r o	y	f	.6	10	7
Field	Domestica	1892	10	" 12	" 20	o	p	c	1.5	5	6
French Damson	Domestica	1893	7	" 11	" 11	r	b	c	.5	2	7
Giant Prune	Domestica	1895	8	" 14	Sept. 12	o	p	f	2	6	8
Grand Duke	Domestica	1890	9	" 9	" 22	o	b	f	1.4	10	7
Hale	Triflora	1896	10	" 11	" 3	r	y	c	1.3	1	9
Hungarian	Domestica	1888	9	" 13	Aug. 27	r	b	c	.8	8	7
Italian	Domestica	1888	9	....	" 22	o	b	f	.8	8	9
Kingston	Domestica	1890	9	May 9	Sept. 11	o	b	f	1.5	10	5
Lincoln	Domestica	1890	8	" 12	Aug. 13	r o	r y	f	1.6	8	8
Lombard	Domestica	1889	9	" 12	" 8	r o	p	c	1.1	1	6
Long Fruit	Triflora	1890	9	" 9	July 21	r	r	s	.4	6	4
Lyon	Domestica	1890	10	" 12	Aug. 27	r o	y	f	2	3	8
Marianna	Cerasifera	1890	10	" 12	" 14	o	r y	c	.8	9	3
Maru	Triflora	1890	9	" 9	" 21	r	r y	c	.8	9	3
Middleburg	Domestica	1890	9	" 9	Sept. 24	r o	r p	f	1	6	7
Mistake	Domestica	1896	7	" 12	" 24	o	r p	f	2	1	8
Moldavka	Domestica	1888	9	" 11	Aug. 22	o	y	f	1.6	1	6
Monarch	Domestica	1893	9	" 9	Sept. 25	o	p	s	1.6	5	7
Murdy	Domestica	1892	9	" 14	" 8	o	r p	s	2.2	7	7
Orel No. 20	Domestica	1888	9	" 14	Aug. 22	o	b	f	.5	3	5
Red June	Triflora	1890	9	" 9	July 28	r o	r	c	1	10	6
Satsuma	Triflora	1893	9	" 9	Aug. 27	r	p r	c	1.3	10	7
Shipper	Domestica	1890	8	" 12	Sept. 6	r	b	s	1.4	3	7
Shropshire (Damson)	Domestica	1890	8	" 12	" 22	r o	b	s	.4	2	7
Spaulding	Domestica	1890	9	" 12	" 1	o	g y	f	1.1	10	8
Victoria	Domestica	1890	8	" 12	" 8	o	y p	f	1.4	5	7
Wangenheim	Domestica	1890	10	" 14	" 1	o	b	f	.8	5	7
Wickson	Triflora	1895	8	" 9	" 3	r c	y r	c	2.9	5	6
Willard	Triflora	1894	9	" 9	July 30	o	r	c	1	4	3
Yellow Egg	Domestica	1893	10	" 9	Sept. 1	o	y	c	1.8	9	5
Yosebe	Triflora	1890	8	" 9	July 20	r	r	c	.4	4	4

EUROPEAN PLUMS.

Agen Prune.—A medium-sized, dark purple plum of very good quality, ripening in early September. A good mid-season variety, but rather small for best results in market.

Arch Duke.—Black with light blue bloom. Size medium to large, roundish oval, slightly compressed. Lacks productiveness here and has the fault of dropping as soon as ripe. Season a few days earlier than Grand Duke.

Aubert (Yellow).—Closely resembles Yellow Egg in tree and fruit. Moderately productive. Rotted badly this season.

Baker (Damson).—Small, blue, of fair quality. Unproductive.

Bavay.—A medium sized, roundish plum, yellow, of best quality. Quite productive. Valuable both for home and market. Last of September.

Bradshaw.—Very large, oval, reddish purple, of good quality. A valuable market variety, but quite subject to rot. Ripens last of August.

Burbank 7.—A roundish, yellow plum of very good quality, ripening in late September. Rather unproductive.

Coe (Golden Drop).—Very large, oval, yellow, of good quality. Fine for canning. Hardly productive enough for market. Late September.

Columbia.—A large, dark purple plum of good quality, ripening in early September. Rots so badly as to be almost worthless.

Diamond.—One of the most profitable market varieties. Size large, oval; color black; quality fairly good, though rather acid. Usually rots but little. The tree is a good grower. Late September.

Early Red.—One of Prof. J. L. Budd's importations from Europe. The tree is an upright, spreading, rather weak grower. The fruit somewhat resembles Lombard, but ripens two weeks earlier. Not valuable.

Engle.—A medium sized, greenish yellow plum of first-rate quality, ripening in early August. The tree is a good grower and very productive.

Field.—Ripens a few days earlier than Bradshaw and is somewhat similar in appearance to that variety. The tree is a strong upright grower. Unproductive here.

French Damson.—A small, roundish blue black plum, ripening the middle of September. Somewhat larger than Shropshire Damson. Inclined to be a thin bearer.

Giant.—A cross between Pond Seedling and Prune D'Agen, originated by Luther Burbank. Size very large, oval; color dark purple; flavor sweet, pleasant; quality very good. Somewhat lacking both in vigor and productiveness. Middle of September.

Grand Duke.—A very large, black, oval shaped plum of quite good quality, ripening in late September. Quite productive. The large size and handsome appearance of this variety renders it a valuable market sort. Quite free from rot this season.

Kingston.—A large, late, blue black plum of fair quality. An abundant bearer and one of the most profitable kinds for market.

Lincoln.—Large, roundish oval; color dull red, mottled; quality very good. A good early variety, ripening the middle of August.

Lombard.—Well known. Has been largely grown for market, but is now giving way to newer kinds.

Lyon.—Large, roundish, yellow, very good. Rots badly. Late August.

Middleburg.—A medium sized, late, reddish purple plum, grown to some extent for market. Inclined to burst when ripe.

Moldavka.—A large, yellow plum resembling Yellow Egg. Quite unproductive.

Monarch.—A valuable new market variety, ripening in late September. Fruit medium to large, roundish; color dark purple, almost black; quality quite good, although a little acid. The tree is a fairly vigorous grower and a regular, abundant bearer.

Murdy.—Of the largest sized, roundish oval; color reddish purple; quality good; quite productive. Early September.

Orel 20 (Long Blue).—Does not merit favorable mention. A shy bearer and the fruit is too small for market.

Shipper.—Not valuable here. Fruits sparingly and rots badly.

Shropshire (Damson).—A very small blue plum, valuable for preserving. Brings the highest price in market. A good grower and a regular, abundant bearer.

Victoria.—A plum of large size, good quality and handsome appearance, but rots so badly as to render it almost worthless. Color yellow, mottled with red and purple; season late August and early September.

Wangenheim.—A black German plum of good quality, ripening in early September. Only moderately productive.

Yellow Egg.—Large, oval, yellow, quite good. Ripens last of August. Fairly good for market purposes.

JAPAN PLUMS.

Abundance.—One of the best known of the Japan plums. An early and very abundant bearer. Yellow, shaded with red, somewhat tender, juicy, of good quality. Early August.

Babcock.—Size medium, roundish conical; color yellow, shaded with reddish purple; quality fair only. Ripens a few days later than Burbank. The tree is an upright, slightly spreading grower, with reddish brown shoots. Requires further trial.

Burbank.—A vigorous, rampant grower, requiring severe heading in to keep it within bounds. The fruit is medium to large, roundish, tapering slightly toward the apex, of quite good quality. Valuable for market. Late August.

Chase.—A medium sized, roundish ovate plum, dark, dull red in color, of fair to good quality. Ripens about with Burbank. A thrifty grower and an abundant bearer. Of value for market purposes.

Hale.—A medium to large, light yellow plum tinged with red. Of fine quality. The tree is a very vigorous, upright, spreading grower. Not so hardy as Abundance and Burbank, which quite likely may be accounted for by the fact that it grows late into the season and frequently does not ripen its wood well. The light color and tender texture of the fruit render it of questionable value for shipping purposes. Five year old trees have fruited very sparingly. Early September.

Long Fruit.—A very early red plum of small size and poor quality. Not valuable.

Maru.—Size small to medium, roundish; color dark red with many yellow dots; quality poor. Of little value.

Ogon.—A yellow, early ripening plum of low quality, and rather unattractive appearance.

Red June.—Tree a fairly vigorous grower and an abundant bearer. The fruit is of medium size, cordate, elongated at apex; color red; quality quite good; season late July. The best Japan plum on trial, ripening before Abundance. Valuable for early market.

Satsuma.—A medium to large, roundish plum, dark purplish red in color, of very good quality. The flesh of this variety is dark purple. The tree is a vigorous, upright, spreading grower. Not so hardy as some of the Japan kinds, but an abundant, regular bearer under ordinary conditions. The trees froze quite badly during the winter of 1898-9, but recovered sufficiently to bear a full crop this season. A valuable variety for culinary and market purposes. Quite free from rot. Late August.

Wickson.—One of the largest and handsomest of the Japan plums. Color yellowish amber, well overlaid with dark red; quality quite good; keeps in perfect condition for some time after picking. The tree is a close, upright grower, strikingly like Prunus Simoni, which variety is thought by some horticulturists to have entered into the cross which gave the Wickson, although Luther Burbank, the originator, claims it to be a cross between Burbank and Kelsey. Here the tree behaves much like Simoni, the bark begins to take on a dark, unhealthy appearance as the tree gets age, and the lower buds die out along the branches leaving only a tuft of leaves at the extremity. Much more tender in bud than Abundance and Burbank, and does not bear regularly like these varieties. It does not appear very promising for market purposes.

Willard.—Roundish oblong, red, ripens in late July. The quality is so poor as to render the variety almost worthless.

Yosebe (Earliest of All).—The first plum to ripen on the station grounds. Small, roundish conical; color red; quality poor. Has little to commend it aside from earliness.

GRAPES.

There are one hundred and fifty varieties of grapes in the station collection. Quite a large number of these are crosses between European grapes and some of the American species. To this class belong the Rogers' hybrids and others. While finer quality has in many instances been secured, the vinifera cross has always brought to the new variety thus originated more or less undesirable characteristics. Here these hybrids fruit sparsely, mildew badly, and many of them are inclined to be tender, weak growers. While a few are worthy of a place in the home collection, none are considered very desirable for market purposes.

The varieties which are best adapted for general cultivation in this climate are those which have pure, or at least a preponderance, of native blood as Winchell, Diamond, Worden, Niagara, Concord and Delaware.

TABULATION OF GRAPES, 1900.

Abbreviations: Bunch: Form—c, compact; cy, cylindrical; r, roundish; s, shouldered. Berry: Form—o, oval; ov, ovate; r, round. Color—a, amber; b, black; g, greenish; p, purple; r, reddish; w, whitish; y, yellowish. Season—b, beginning; m, middle; e, end.

Name.	Species.	Bloom.	Ripe.	Vigor.	Product.	Quality.	Bunch.		Berry.		Color.
							Form.	Weight in ounces.	Form.	Size.	
Agawam	Lab. x Vin.	June 23	Sept. 29	8	2	7	cy s	2.8	r	8–9	r
Alice	Lab.	“ 17	Oct. 3	10	8	6	cy s	3.8	r	5	r
Aminia	Lab. x Vin.	“ 23	“ 12	10	1	7	cy s	2.6	rov	7	b
Barry	Lab. x Vin.	“ 23	Sept. 29	9	1	7	s	2.8	r	5–6	b
Bell	Val. x (Bour x Lab)?.	“ 15	“ 15	10	1	8	cy s	2.2	r	4–7	w
Berlin	Lab.	“ 23	Oct. 1	8	1	6	cy	2.2	r	6	w
Black Eagle	Lab. x Vin.	“ 23	Sept. 20	6	1	7	cy s	3.1	r	6	b
Black Pearl	Lab. x Vin.	“ 17	“ 15	10	1	4	cy s	1	r	4	b
Brighton	Lab. x Vin.	“ 23	“ 15	10	5	10	cy s	3.6	r	6	r
Burnett	Lab. x Vin.	“ 23	“ 20	8	3	7	cy s	2.7	r	6	b
Cambridge	Lab.	“ 21	“ 15	8	10	6	cy s	4.7	r	7	b
Campbell	Lab. Hybr.	“ 21	“ 8	10	5	8	cy s	6	r	9	b
Caywood	Lab.	“ 20	“ 24	10	10	4	r s	4.2	rov	6	b
Centennial	Lab. x Vin.	“ 23	“ 27	5	1	10	cy s	1.8	r	3–4	w
Chidester, No. 1	Lab.	“ 23	“ 16	8	1	7	s	2	r	4	r
Chidester, No. 2	Lab.	“ 21	“ 20	10	3	8	cy s	2.2	r	8	r
Clinton	Vul. x Lab.	“ 11	Oct. 3	10	10	4	cy s	3.5	r	4	b
Colerain	Lab.	“ 22	Sept 12	10	4	8	s	4.1	r	6–7	w
Columbia	Vul. x Lab.	“ 21	Oct. 3	10	2	4	s	3	ov	8	p
Columbian	Lab.	“ 23	“ 3	10	4	4	r-s	4.6	r	10	r
Concord	Lab.	“ 23	Sept. 29	10	2	6	cy s	5.2	r	8	b
Cortland	Lab.	“ 17	“ 8	10	6	3	s	4	r	6	b
Cottage	Lab.	“ 17	“ 15	10	5	7	cy s	1.8	r	5	b
Delaware	Bour. x Lab	“ 23	“ 16	7	10	10	cy s	2.6	r	2	r
Diamond	Lab. x	“ 22	“ 25	10	5	8	cy s c	4	r	5	g w
Dracut	Lab.	“ 23	“ 15	9	8	3	cy s	3.2	r	7	r
Duchess	Lab. Hybr.	“ 24	Oct. 12	10	10	9	cy s	5.4	r	5	w
Early Victor	Lab. x	“ 23	Sept. 18	10	1	7	cy s	1.8	r	4	b
Eaton	Lab.	“ 23	“ 29	9	1	5	cy s	2	r	8	b
Elvira	Rip.	“ 17	Oct. 3	10	10	7	cy s	4.8	r	6	g w
Empire State	Lab. x Rip.	“ 22	Sept. 29	10	10	7	cy s	3.4	r	4	g
Esther	Lab. x	“ 22	“ 30	10	8	7	cy s	3.8	r	6	w
Etta	Lab. x Vul.	“ 17	Oct. 3	10	10	4	cy s	3.8	r	6	g w
Geneva	Lab Hybr.	“ 23	Sept. 30	10	1	5	cy s	1.6	ov	5	w
Golden Gem	(Bour. x Lab.) x Vin.	“ 17	“ 15	5	2	10	cy s	1	r	2	w
Guinevra	Lab. x Vin.	“ 22	Oct. 5	10	10	7–8	cy	6	r	8	w
Hall	Lab.	“ 17	Sept. 15	10	3	5	cy s	3.6	r	6	b
Herbert	Lab. x Vin.	“ 23	“ 15	8	5	6–7	s	2.6	r	7–8	b
Honey	Lab. x Vin.	“ 17	“ 25	10	3	8	cy s	3.4	r	6	w
Hosford	Lab.	“ 21	“ 25	8	2	6	cy s	3.8	r	9	b
Iowa	Lab.	“ 23	Oct. 12	8	8	10	s	4.4	o	6	r
Iris	Lab. x Vin.	“ 23	Sept. 30	10	2	5	cy s	2.8	r	7	r
Ives	Lab.	“ 21	“ 25	10	1	4	cy s	2.4	r o	4	b
Jefferson	Lab. x	“ 26	“ 30	8	9	9	r s	4.4	r	6	r
Jessica	Bour. x Lab	“ 22	“ 1	9	10	7	cy s	2.2	r	5	w
Jewell	Bour. x Lab.	“ 21	“ 20	7	2	9	cy s	1.6	r	4	b
Josselyn No. 5		“ 21	“ 5	10	8	9	cy s	5.4	r	7	w
Josselyn No. 9		“ 22	Oct. 5	10	5	4	cy s	3.8	r	6	rp
Lady	Lab.	“ 23	Sept. 20	8	10	6	s	4.8	r	7	w
Lindley	Lab. x Vin.	“ 24	“ 25	9	5	6	s	2.6	r	7	r
Lyon	Lab.	“ 23	“ 30	10	8	9	cy s	5.5	r	9	w
Massasoit	Lab. x Vin.	“ 23	“ 29	8	2	6	r s	1.2	rov	6	r
Merrimac	Lab. x Vin.	“ 21	“ 20	9	3	7	cy	3.4	rov	6	r
Monroe	(Bour. x Lab.) x Lab.	“ 23	Oct. 5	7	1	6	s	2.8	r	7	b
Moore	Lab.	“ 23	Sept. 3	8	1	7	cy	3.2	r	8	b

TABULATION OF GRAPES, 1900.—CONCLUDED.

Name.	Species.	Bloom.	Ripe.	Vigor.	Product.	Quality.	Bunch.		Berry.		
							Form.	Weight in ounces.	Form.	Size.	Color.
Moyer	Aest. Hybr	June 17	Sept. 10	7	6	6	cy s	1.6	r	4	r
Northern Light	Lab.	" 22	" 25	6	3	8	cy s	3	r	4-6	w
Owosso	Lab.	" 17	" 25	9	5	4	s	2.8	ov	7	r
Ozark	Aest.	" 24	Oct. 12	10	10	6	s	5.4	r	5	b
Pocklington	Lab.	" 23	" 12	8	3	6	cy s	3	r	7	w
Poughkeepsie	Bour x Lab	" 24	" 3	4	2	9	cy s	2.1	r	4	r
Presley	(Lab. x Vul.) x Lab.	" 22	Sept. 15	9	9	5	cy s	1.4	r o	4	r
Pulpless	Lab. x Vin.	" 25	" 20	10	3	5	s	2.6	r	8	b
Requa	Lab. x Vin.	" 23	" 20	10	8	8	s	3.8	r	8	r
Rochester	Lab.	" 23	" 20	8	10	4	c cy s	4.6	r	4	r
Rockwood	Lab.	" 23	" 8	9	5	6	cy s	3.8	r	5	b
Salem	Lab. x Vin.	" 23	" 29	8	3	7	r s	2.4	r	8	r
Telegraph	Lab.	" 23	" 15	10	10	5	cy s	4.6	r	5	b
Triumph	Lab. x Vin.	....	Oct. 7	10	10	5	cy s	8.2	r	7	w
Ulster	Lab. x	June 21	" 1	7	9	10	cy	3.4	rov	6	r
Vergennes	Lab.	" 23	Sept. 29	7	4	9	s	2.2	rov	7	r
Victoria	Lab.	" 23	" 20	9	3	7	cy s	2.6	r	6	w
Warder	Lab.	" 23	" 15	10	8	4	cy s	3.4	r	6	b
White Beauty	Lab. x Vin?	" 23	Oct. 3	8	10	7	cy s	3.4	r	6	w
White Imperial	Lab. x Vin?	" 22	" 3	8	1	7	cy s	1.5	r	6	w
Willis	Bour. x Lab?	" 23	Sept. 15	8	7	6	cy s	2.6	r	6	w
Winchell	Lab.	" 21	" 1	8	8	9	s	2.2	r	5	w
Witt	Lab. x Vin.	" 24	Oct. 1	10	2	7	s	3	r	6	w
Woodruff	Lab. x	" 17	Sept. 29	10	9	5	s	3.8	r	8	r
Worden	Lab.	" 21	" 29	10	5	8	s	5.8	r	8	b
Wyoming	Lab.	" 22	" 25	10	2	5	cy	2	r	5	r

NOTES ON VARIETIES.

Adirondac.—Lacks hardiness and productiveness.

Agawam.—Fruits sparingly and mildews badly.

Alice.—Rather late for this climate. Ripens unevenly and is of rather poor quality.

Aminia.—Clusters small and loose. Very subject to mildew.

Barry.—Bunches imperfect; mildews badly; very unproductive.

Bell.—A white grape of good quality ripening the middle of September.

Berlin.—White, of good quality, inclined to be unproductive.

Black Eagle.—Color, black; quality very good. Cluster, large, long, conical. Lacks hardiness and productiveness.

Brighton.—A well known red grape of best quality, ripening the middle of September. Somewhat variable in its behavior and often inclined to mildew but under favorable conditions it is one of the best of the red grapes for home or market.

Cambridge.—Very similar to Concord but ripens two weeks earlier.

Campbell.—A new early grape of the Concord type. Highly spoken of in many localities where it has fruited. Did not make so good a showing here as last season. The clusters were very loose and the crop light. Ripens with Moore and will keep several weeks. Does not shell like many of the early varieties. Requires further trial.

Catawba.—Does not succeed here. Fruits sparingly and does not ripen well.

Caywood.—A black grape of rather poor quality ripening the middle of September. Shells badly.

Centennial.—A small white grape of best quality. Valuable for dessert purposes. Late September.

Chidester.—A vigorous grower somewhat lacking in productiveness here. Cluster large, moderately compact; berries medium to large. A little lighter colored than Concord, of very good quality. Ripens shortly before Concord.

Colerain.—A white Concord seedling, vigorous and fairly productive. Ripens two weeks earlier than Concord.

Columbian.—A very large dark purple grape of fine appearance, but too poor in quality to be valuable.

Concord.—The best known and one of the most reliable varieties grown.

Cortland.—Black, of poor quality. Strongly resembles Champion in fruit and foliage.

Cottage.—A Concord seedling raised by E. W. Bull, originator of the Concord. A strong vigorous grower bearing fruit similar to Concord in appearance, but two weeks earlier in time of ripening.

Delaware.—The most valuable red grape grown in Michigan. Excels both for dessert and market purposes.

Diamond.—A white grape of very good quality ripening just before Concord. The vine is vigorous and quite productive. Valuable for home use and is grown to quite an extent for market in some grape sections.

Dracut.—A large red grape ripening the middle of September. Very foxy and poor in quality.

Duchess.—White, of good quality, keeps well. A good home variety. October and November.

Eaton.—Large, black, unproductive. Late September.

Empire State.—A white grape borne in very long cylindrical, shouldered clusters. Moderately productive and of quite good quality.

Esther.—A white grape of fair to good quality. A little lacking in juice and almost too mild in flavor. The bunches are usually of good size and quite well filled. Ripe in late September.

Etta.—White, of poor quality. Productive but not valuable.

Geneva.—A white grape ripening in early October. Lacks quality.

Goldstein.—A strong grower, very productive; bunches of medium size, compact. No improvement over Champion which variety it resembles.

Guinevra.—A white grape received from C. Engle, of Paw Paw. A good grower and quite productive. The bunches are large and very compact. Said to be a seedling of Salem. Seems to be valuable. Ripe in early October.

Herbert.—A black grape of good quality, ripening about the middle of September. One of the best of Rogers' hybrids on trial.

Honey.—A white grape of very good quality but too unproductive to be of value.

Hosford.—A large black grape of fair quality ripening about the middle of September. Quite unproductive here.

Iona.—A red grape of best quality. Season late, ripens unevenly and cannot be relied on in this section.

Jefferson.—Color red, quality very good. Ripens late and keeps well. Usually quite productive. Valuable for home planting.

Josselyn 5.—A white grape ripening in late September or early October. Quite productive and of good quality.

Josselyn 9.—A dark purple grape of poor quality. Not valuable.

Josselyn 10.—A black grape. Very unproductive.

Lindley.—Fruits sparingly and mildews badly.

Lyon.—A strong grower. Only moderately productive. Color white, quality very good. Bears some resemblance to Niagara. Early October.

Massasoit.—Bunches small and loose. Mildews badly.

Merrimac.—A failure here.

Moore.—A good early black grape. Inclined to be rather unproductive.

Niagara.—White, productive. Valuable for market. Well known.

Northern Light.—A white grape ripening in late September. Inclined to be unproductive.

Osage.—Black, unproductive, not valuable. Somewhat foxy.

Owosso.—Red, of fair quality, a shy bearer.

Ozark.—A strong, vigorous grower and quite productive but the fruit is of rather low quality. The berries are blue in color and are a little smaller than the Concord.

Pocklington.—A well known white grape. Succeeds fairly well here. Middle of October.

Poughkeepsie.—A poor grower and quite unproductive.

Presley.—Small, red, of poor quality.

Pulpless.—A large black grape of rather poor quality. Middle of September.

Requa.—Subject to mildew and anthracnose.

Rochester.—A red grape borne in very compact clusters. Of low quality, quite foxy.

Rockwood.—An early black grape. Shells badly and is of low quality.

Salem.—A shy bearer here and very subject to mildew.

Telegraph.—Early, black, of poor quality. The clusters are very compact.

Triumph.—Vines quite vigorous and productive of clusters of the largest size. Color white, quality rather poor. Almost too late for this climate.

Ulster.—A red grape of good quality ripening in late September. The bunches are of medium size and quite compact. Sometimes sets too much fruit and fails to ripen well. Valuable for home planting.

Vergennes.—Red, ripens late and keeps well. Quality very good. Valuable for home use.

White Beauty.—Of good quality and usually quite productive. Has some value for home planting.

Wilder.—Color black, quality very good. Late September. Subject to mildew and fruits rather sparsely.

Willis.—An early white grape. Not very valuable.

Winchell.—A valuable early white grape. One of the first varieties to ripen. The vine is a good grower and quite productive. Worthy of a place in every home collection.

Witt.—White, unproductive, of good quality. Not very desirable.

Woodruff.—The vine is a vigorous grower and good bearer. Fruit red, of variable quality. Usually quite poor here. Inclined to set too much fruit in which case it ripens imperfectly. Cannot be recommended.

Worden.—Large blue, of fine quality. A well known Concord seedling. Valuable both for home and market. Ripens a few days earlier than Concord.

Wyoming.—Of medium size, red, of poor quality. The vine is vigorous and hardy.

APPLES.

The apple crop was very good this season and quite free from worms, but the late fall and winter varieties were blown off badly by the windstorm already mentioned.

The trees were sprayed early with copper sulphate, one pound to fifteen gallons of water, and after the fruit had set three applications of Bordeaux mixture and arsenite of lime were made at intervals of from two to three weeks.

Paris green, heretofore used for the codling moth, was replaced this season by arsenite of lime. It is believed that the unusually good success attained in keeping the fruit free from worms may be attributed largely to the use of the latter poison. Some of the paris green last used was found to be adulterated.

Arnold.—A medium to large yellowish white apple of good quality. Season November to March. Too light in color and almost too tender for market but promising for home use. The tree is a good grower and quite productive.

Bailey.—A very large, showy, red winter apple of sweet, pleasant flavor. The tree is fairly vigorous and productive.

Battullen.—Tree a good grower, fruit yellow with carmine blush, smooth and attractive. Thus far this variety has not shown itself to be very productive, otherwise promising for market.

Ben Davis.—An early and abundant bearer grown largely for market. An long keeper but of poor quality.

Bietigheimer.—A large beautifully colored apple from Germany. Ripe in early autumn. Quality very poor. Not valuable.

Black Lady.—A very small dark red French dessert apple of only fair quality. The tree is an upright, moderately vigorous grower.

Bottle Greening.—Large, greenish yellow, shaded with dull crimson. A handsome apple of good quality. Rather tender for market but a fine dessert fruit. Origin, Vermont. November to March.

Bradford.—A peculiarly marked dark red apple of medium size and firm texture. Quality rather low. Keeps all winter.

Buckingham.—Size, large; color, greenish yellow, shaded and splashed with two shades of red. Quality fair to good. November to February.

Canada Baldwin.—A richly colored apple of medium size. Resembles Snow in appearance and flavor. Season December to April.

Chenango.—Medium to large, oblong, conical; color whitish yellow, washed and striped with bright red. A well known dessert apple. August and September.

TABULATION OF APPLES, 1900.

Abbreviations: Month—e, early; m, middle; l, late. Form—c, conical; i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. Color—g, green; r, red; ru, russet; w, white; y, yellow. Texture—c, crisp; d, dry; f, firm; j, juicy; t, tender. Flavor—a, acid; m, mild; s, sweet. Use—d, dessert; k, kitchen; m, market.

Name.	Planted.	Vigor.	Bloomed.	Product.	Season.	Weight in ounces.	Form.	Color.	Texture.	Flavor.	Quality.	Use.
Arnold	1890	9	May 15	10	Nov. Mar.	8.2	o	y r	t c	m	7	d m
Bailey Sweet	1888	7	" 17	10	Nov. Mar.	6.6	r	y r	t	s	7	d m
Battullen	1888	10	" 14	5	Nov. Mar.	6	r ob	y r	t c	a	6	m d
Ben Davis	1893	10	" 17	10	Dec. May.	5.6	r c	y r	f d	m	4	m
Bietigheimer	1890	8	" 15	1	Aug. Sept.	9.2	r o	r y	t	a	4	m
Black Lady	1888	7	" 14	10	Oct. Mar.	5.5	r o	r	t c	m	6	d
Bottle Greening	1890	10	" 15	3	Nov. Mar.	6.2	r o c	g y	t c j	a	8	m d
Bough	1888	9	" 17	3	Aug.	5	r c	y	t	s	9	d k
Bradford	1890	9	" 14	7	Dec. Mar.	4.4	r ob	y r	t c	m	4	m
Buckingham	1892	10	" 17	7	Nov. Feb.	9.8	c o	g y r	t j	m	8	d m
Canada Baldwin	1890	10	" 17	1	Dec. Apr.	3.8	r o	y r	t c	m	7	d m
Chenango	1888	10	" 17	10	Aug. Sept.	4.2	ob c	y r	t	a	8	d m
Clark Orange	1892	10	" 14	6	Nov. Jan.	8.8	i o	y r	t c	m	7	d m
Cogswell	1888	9	" 17	8	Oct. Mar.	5.4	o c	y r	t c	m	5	d m
Colton	1888	9	" 14	9	Aug.	4.2	ov c	g y	t j	m	7	d m
Craine	1888	10	" 17	7	Jan. May.	2.4	r o c	y r	f	a	6	k
Cullin	1890	8	" 14	2	Jan. Apr,	7	r ob	g y r	f	m	6	d m
Duchess Seedling	1895	8	" 17	1	Aug.	6	r o	g y r	c	a	7	......
Dyer	1888	8	" 17	1	Sept. Oct.	5.8	r	y	t	m	9	d
Early Joe	1892	7	" 17	1	Aug. Sept.	3.4	r o c	y r	t	a	9	d
Early Ripe	1891	10	" 17	1	e Aug.	4.4	o	g y	c d	m	6	d
Early Strawberry	1888	8	" 14	7	Aug.	2.4	r c	y r	c j t	a	8	d m
Fameuse Sucre	1890	8	" 17	1	Oct.	5.2	r o	r	t	m	9	d
Fanny	1890	10	" 17	1	Aug. Sept.	5.4	r o	y r	t	m	7	d
Fink	1892	8	" 14	7	Dec. June.	3.2	r o	g y r	f c	a	5	......
Flushing	1888	8	" 17	3	Nov. Feb.	6.4	r c	y r	f c	m	7	d m
Garden Royal	1888	5	" 17	7	Aug. Sept.	2.8	r o	y r	t	m	10	d
Gideon	1890	10	" 14	10	Sept.	6.2	r c	y r	f c	a	5	k m
Gill	1892	9	" 17	4	Nov. Apr.	8.8	r o c	y r	t c	m	5	m
Gloege	1888	9	" 14	10	Nov. Apr.	6.8	c	y r	f	m	5	m
Golden Reinette	1888	7	" 14	10	Aug. Sept.	3.4	r o c	y r	t j	a	7	k m
Golden Russet	1888	10	" 14	10	Dec. Apr.	4.4	r o	y ru	f	m	7	d m
Golden Sweet	1892	8	" 14	7	Aug. Sept.	5	r	g y	t	s	7	d
Grimes	1890	8	" 14	10	Nov. Mar.	5.2	r o	y	f c	m	8	d m
Grosh	1890	7	" 15	3	Sept. Oct.	6.6	r o	y r	c	a	6	k m
Haas	1892	8	" 14	3	Sept.	5.4	r o	y r	t	a	5	m
Hagenkopt	1888	10	" 17	2	Sept.	5.6	r c	y r	f	a	5	m
Hargrove	1892	10	" 14	4	Nov. Mar.	5.6	r c	y r	f	m	5	......
Hawley	1888	10	" 14	5	Aug. Sept.	8.4	r o	y	t j	a	8	d
Hubbardston	1888	10	" 17	5	Nov. Feb.	7.4	r c	y r	t c	m	9	d m
Indian	1892	10	" 15	10	Nov. Apr.	6.4	r o c	y r	c	m	4	m
Iowa Keeper	1891	10	" 14	10	Dec. June.	4	r o	g y r	f	m	7	d k
Jefferis	1888	8	" 14	10	Sept.	6	r o c	y r	c t j	m	10	d
Jersey Sweet	1888	9	" 16	10	Aug. Sept.	5.2	r	y r	t	s	8	d k
Jonathan	1888	8	" 17	10	Nov. Mar.	4.2	r c	y r	c j	a	10	d m
Keswick	1888	6	" 17	10	Aug. Sept.	4.2	r ov	y	c	a	5	k
Kinnaird	1892	10	" 14	10	Nov. Mar.	7.4	r o c	y r	t j c	m	7	m
Limber Twig	1892	9	" 15	3	Dec. Apr.	3.8	r o c	y r	f c	a	5	m
Longfield	1892	9	" 15	10	Sept. Oct.	3	r c	y r	c t	a	5	k m
Lou	1890	9	" 15	10	Aug.	5.7	r ov	y r	c	a	4	k m
Louise	1890	10	" 15	2	Nov. Jan.	6	r	y r	t c	m	8	d m
Lowell	1890	8	" 15	10	Aug. Sept.	......	ob	y	t j	m	8	d m
Magog	1890	8	" 17	1	Nov. Mar.	5	r ob	y r	t c	m	5	m
Mason Orange	1890	9	" 15	10	Nov. Jan.	7.8	r ob	y r	t j	m	9	d m
McIntosh	1890	10	" 16	8	Oct. Jan.	5.4	r o	y r	t j c	m	7	d m

TABULATION OF APPLES.—Concluded.

Name.	Planted.	Vigor.	Bloomed.	Product.	Season.	Weight in ounces.	Form.	Color.	Texture.	Flavor.	Quality.	Use.
Minkler	1892	8	May 15	9	Jan. Mar.	......	r c	y r	f	m	6	m
Morris Red	1890	8	“ 17	3	Nov. Feb.	7	r ob c	y r	t j c	m	8	d m
Mother	1890	8	“ 15	1	Oct.	5.5	r c	y r	c t	m	8	d
Munson	1890	9	“ 15	7	Sept.	5.2	o	g y	c t	s	6	d m
Nansemond	1892	8	“ 15	1	Nov. Feb.	4.8	r o	y r	c t.	m	6	d m
Oakland	1888	8	“ 17	1	Nov. Mar.	5.2	r o	y r	t	m	8	d m
Oldenburg	1892	8	“ 14	10	1 Aug. Sept.	6	o	y r	c	a	5	k m
Ontario	1890	9	“ 15	8	Nov. Mar.	9.6	r o	y r	t c	a	7	d m
Peck	1888	9	“ 17	1	Nov. Mar.	4.6	r	g y r	t c j	m	9	d
Peter	1890	8	“ 15	10	Sept. Oct.	6	o c	g y r	t j	a	5	k m
Picket	1888	8	“ 17	1	Nov. Feb.	4.6	r o	y r	f c j	m	7	d
Pine Stump	1892	8	“ 14	7	Nov. Mar.	4	r	y r	t c	m	6	d
Primate	1888	10	“ 14	8	Aug.	4.4	r c	y r	t	m	9	d m
Prolific Sweet	1890	7	“ 17	10	1 Aug.	3.4	r c	y	f	s	5	d
Prior	1888	9	“ 17	6	Jan. Mar.	4.2	r o c	y r	t	m	5	m
Quince	1892	9	“ 14	5	Aug.	9.2	r c	y	t	a	4	k
Rambo	1890	10	“ 15	10	Oct. Dec.	4.4	r o	y r	t	m	8	d
Ramsdell	1888	9	“ 14	3	Nov. Feb.	5.4	o b c	g y r	t	s	6	d m
Red Aport	1888	10	“ 14	6	Sept. Nov.	......	o c	y r	c	a	5	k m
Red Astrachan	1888	10	“ 16	6	Aug.	5	r o	g r y	c	a	6	d k m
Red Dettmer	1888	10	“ 14	1	Sept. Oct.	5.9	r o	y r	c t	a	6	k
Red June	1892	10	“ 17	10	Aug.	4.2	ov c	r	f	a	8	d m
Rhode Island	1888	10	“ 14	8	Dec. Mar.	7.4	r o	g y	t c	a	8	m d
Ribston	1888	8	“ 14	1	Nov. Apr.	6.6	r c	y r	f c j	m	7	m d
Ronk	1888	8	“ 17	2	Dec. Mar.	7.4	r o	g y r	t c	a	7	......
Rosenhager	1888	10	“ 14	10	Sept. Oct.	9.1	r o c	r	t	a	5	m
Roxbury	1890	9	“ 16	5	Jan. June.	6.2	r o	y ru	f	m	7	m d
Scarlet Cranberry	1891	9	“ 17	6	Dec. Apr.	6.2	r o	y r	f j	m	6	m
Shannon	1893	8	“ 17	1	Dec. Mar.	6.8	r o c	g y r	t c	m	7	m
Sheriff	1891	9	“ 17	9	Nov. Mar.	5.8	r ob c	y r	t c	m	7	m d
Shiawassee	1898	9	“ 17	8	Oct. Jan.	5.4	r o	y r	t c	m	8	d
Sikuli	1894	7	....	1	Dec. Apr.	6	r o	g y r	f c	m	6	......
Stark	1888	10	May 14	10	Dec. May.	8.4	r ob	g y r	t j	m	7	m
St. Lawrence	1888	8	“ 14	2	Sept. Oct.	7.4	o c	y r	c t	a	5	m
Stuart	1890	10	“ 15	7	Nov. Feb.	4.4	r o	y	c f j	a	6	m d k
Summer Lievland	1890	10	“ 14	6	Aug.	4.9	r o	g y r	t	m	7	d
Summer Pearmain	1888	10	“ 17	7	Sept.	4.2	ob c	y r	t	m	10	d
Summer Rose	1892	9	“ 17	8	Aug.	2.6	r o	y r	t j	m	8	d
Tolman	1888	10	“ 17	7	Nov. Mar.	5.6	r o	y	f	s	7	d m
Titovka	1888	7	“ 14	10	Aug. Sept.	7.4	ob c	g y r	t c	a	6	k m
Wagener	1893	7	“ 17	1	Nov. Mar.	6.4	r o	y r	t c	m	8	d m
Walker	1891	8	“ 15	1	Dec. Apr.	6.2	r o c	g y r	f c j	a	6	m
Washington Strawberry	1890	9	“ 15	3	Aug. Sept.	7.2	o c	y r	t	a	7	m
Watermelon	1892	8	“ 17	1	Aug.	5	r c	g r	t	a	5	......
Wealthy	1890	8	“ 15	3	Sept. Oct.	6	o c	y r	t	a	6	k m
Whinery	1890	10	“ 15	1	Dec. Apr.	4.6	r c	y r	f c j	m	7	d m
Winter Streifling	1888	10	“ 14	10	Sept.	5.5	r	y r	t	a	4	k m
Yellow Transparent	1888	8	“ 17	10	Aug.	4	r c	y	t	a	5	k m
York Imperial	1892	9	“ 16	1	Nov. Feb.	7	o i	y r	f c	m	8	d m
Zolotoreff	1890	8	“ 14	8	Aug.	6.2	r	y r	f c	m	4	k m

Cogswell.—Of medium size and attractive appearance; yellow splashed and shaded with red; flesh firm, moderately juicy; flavor mild; quality fair to good. October to March.

Colton.—Size medium, ovate conical; color greenish white usually with russet patches; quality good. Resembles Primate somewhat in flavor and ripens in the same season. A good grower and an abundant bearer.

Craine.—A showy apple and a long keeper, but too small for market and rather brisk for dessert.

Cullin.—A firm-fleshed, long-keeping winter apple. Rather light in color to do well in market. The tree is somewhat lacking in vigor. Received from A. H. Griesa, Lawrence, Kansas.

Duchess Seedling.—Large, smooth, attractive, of fair to good quality. Somewhat resembles Oldenburg in fruit and habit of tree, but the foliage is quite different. Ripens several days earlier.

Early Joe.—Pale yellow shaded and striped with red and dotted with greenish spots. A fine dessert apple. August and September.

Early Ripe.—Of medium size, oblate, somewhat ribbed: color greenish yellow; texture crisp and dry; quality fair; season August. Not considered promising.

Early Strawberry.—Size small; color red; quality very good. Valuable for dessert purposes. August.

Fameuse Sucre.—Size medium, roundish oblate; color dark red; quality very good. Resembles Shiawassee in general appearance and like that variety has the white tender flesh of the Snow or Fameuse type. October.

Fanny.—Size medium, roundish oblate, tapering a little towards the eye: color pale yellow well overlaid with light red; quality very good. A handsome apple and a fine dessert fruit. September.

Fink.—A small, hard flesh, brownish red winter apple of only fair quality. Not considered valuable here.

Garden Royal.—Small, roundish oblate; color greenish yellow, striped and splashed with rich red; quality best; season late August and early September. Valuable for home planting.

Gideon.—This variety bears the name of its originator, the late Peter M. Gideon, of Excelsior, Minn. Size medium to large. Roundish, slightly conical: color clear light yellow, occasionally with a light red cheek; flavor brisk sub-acid. The tree resembles Duchess in habit of growth, and like that variety is an abundant bearer. September and early October.

Gill.—A large red winter apple of only fair quality. Rather unproductive as yet.

Gloege.—Medium to large, ovate inclining to conic: color yellow, slightly russeted, quality fair only. An abundant bearer but not attractive enough for market and almost too poor in quality for home use.

Golden Sweet.—A good early sweet dessert apple somewhat resembling Sweet Bough. Late August and early September.

Grimes.—A roundish oblate, yellow, smooth-skinned apple of very good quality. The tree is vigorous and a profuse bearer. A good dessert and market variety.

Grosh.—A medium to large red, striped, fall apple of fair to good quality. The trees are young and have fruited sparsely as yet.

Haas.—Medium to large, oblate, slightly conical; color greenish yellow shaded with light and dark red; flavor brisk sub-acid; season September and October.

Hagenkopt.—Large, roundish conical; color yellow washed and striped with light red; flavor sprightly sub-acid; season September. Inclined to be unproductive.

Hargrove.—Small, yellow, of poor quality. Not valuable. November to March.

Hawley.—Very large, yellow, tender, of good quality. Subject to water core.

Hubbardston.—A medium large apple, well colored and of very good quality. The tree is a good grower and an abundant bearer. A profitable market variety and deserving of a place in every home orchard. November to February.

Iowa Keeper.—A red-cheeked, hard-fleshed apple of medium size and fair quality. The tree is upright, vigorous and quite productive. The fruit keeps in perfect condition for some time after nearly all other varieties are gone in the spring.

Jefferis.—Size medium, roundish oblate; color yellow, striped with dark, rich red: quality best. Valuable for home planting. September.

Jersey Sweet.—A very prolific, early sweet apple of good quality. Color yellow striped with red.

Jonathan.—Size medium, roundish conical, color clear light yellow, beautifully shaded with rich dark red; quality best. Valuable for dessert and market purposes. Well known. November to March.

Keswick.—Size medium, roundish, inclining to ovate; color greenish yellow, sometimes with a faint blush; flavor acid. Valuable for culinary purposes. August and September.

Kinnaird.—Size large; roundish oblate, inclining to conic; color yellow, well shaded with dark red; flavor mild, rich, aromatic; quality good. The tree is a spreading grower with a roundish head. December to March.

Limber Twig.—A small greenish yellow apple, shaded and striped with dull crimson. Long popular in the south but not very desirable here.

Longfield.—Size medium; roundish conical; color pale yellow with brownish red cheek, slightly russeted; flavor sub-acid, sprightly. The tree is a spreading fairly vigorous grower, and a very heavy bearer. September and October.

Louise.—A Canadian apple supposed to be a Snow seedling. Size above medium, roundish, color greenish white with a reddish brown cheek; quality very good; flesh white and tender resembling the flesh of the Snow apple. November to January.

Magog.—An attractive yellow, red striped apple, of fair to good quality. Slow to bear and not particularly promising otherwise. November to March.

Mason Orange.—Very large, roundish oblong, tapering to the eye; color clear rich yellow, sometimes with a light red blush. A fine dessert fruit but its light color and tender texture render it difficult to handle and therefore of doubtful value for market. November to January.

McIntosh.—A medium sized, roundish oblate apple, yellow and well overspread with red, with a slight bloom. Bears some resemblance to the Snow apple both in color of flesh and flavor. October to January.

Morris Red.—A medium to large red apple of firm texture, attractive appearance, and good quality. The tree is a good grower but rather slow in coming into bearing. November to Febuary.

Munson.—Of medium size, greenish yellow, sweet and pleasant. The tree is a spreading vigorous grower. September.

Nansemond.—A medium to large red winter apple of good quality. Fruited this season for the first time. Does not appear particularly promising.

Oakland.—Size medium, oblate; color dark red; quality very good. The tree is a spreading, rather slow grower and not a very sure bearer.

Oldenburg (Duchess).—One of the best of the late summer and early fall market varieties. The tree is a good grower and a very abundant bearer.

Ontario.—A cross between the Spy and Wagener and one of the most promising of the newer winter varieties. Size large, oblate, inclining to conic; color whitish yellow with a red cheek; texture tender; flavor brisk, sub-acid; quality very good. The tree grows well and is an early abundant bearer.

Peck.—Above medium in size, yellowish, usually with a red cheek. Of fine quality and valuable as a dessert fruit. November to March.

Peter.—Size medium or above, oblate, including to conic; color yellow overspread with bright red. Flavor sprightly, sub-acid. A seedling of Wealthy and practically identical with that variety. September and October.

Picket.—Size medium, color red on light yellow ground; quality good, season December to February. Seems to be lacking in productiveness.

Prolific Sweet.—A large, yellow sweet apple of only fair quality ripening the last of August. Does not appear to be very desirable.

Pryor Red.—Size medium, roundish, a little irregular; color greenish yellow shaded with red and striped with dark crimson; flavor mild, sub-acid; quality rather poor. January to March.

Quince (Cole).—A very large yellowish apple, often a little irregular in shape. Good for culinary purposes. Ripe in August and keeps but a short time.

Ramsdell.—A showy, red sweet apple of good quality, fit for eating in November and keeping until February. The tree is a vigorous, upright grower with a compact head.

Red Dettmer.—A Russian variety ripening in September. Size large, roundish oblate, slightly conical, color pale yellow washed and splashed with light and dark red; flavor brisk, sub-acid. The tree is a vigorous, upright, slightly spreading grower. Inclined to be unproductive.

Ribston.—Size medium, roundish; color yellow, clouded with dull red on the sunny side; flavor sub-acid, rich, aromatic. November to April.

Ronk.—Medium to large, roundish oblate, color greenish yellow with a brownish red cheek; quality good. Tree upright, spreading, rather slow to come into bearing.

Rosenhager.—A very large Russian apple, brownish red in color, of fair quality. The tree is a good grower and an abundant bearer. Promising only for markets where large well colored fruit is sought in preference to that of less attractive appearance but better quality. October to December.

Roxbury.—Valuable for home and market. Keeps until June. Larger than Golden Russet but not so productive here.

Scarlet Cranberry.—Size medium, roundish: color greenish yellow, washed and striped with dull dark red and thickly dotted with grayish irregular spots and specks. December to April.

Shannon.—A popular apple in Arkansas, where it originated. Large, roundish oblate, inclining to conic; color greenish yellow, sometimes with a faint blush; quality good. Seven-year-old trees bore their first fruit this season. Requires further trial. November to March.

Sheriff.—Size medium, roundish; color greenish with a dull red cheek; quality good. Quite productive. Promising for market.

Shiawassee Beauty.—Very similar to Snow except in shape, being somewhat flattened. Bears well and is considered somewhat superior to the Snow apple. October to January.

Stark.—A large greenish yellow apple with a brownish red cheek. The tree is a very vigorous grower and an abundant bearer. A long keeping variety valued to some extent for market.

Stuart.—Light color and rather small size are somewhat against this variety for market, but for home use it is desirable because of its pleasant flavor and good keeping qualities. November to March.

Summer Lievland.—Does not appear very desirable. Small, roundish oblate, greenish yellow splashed with light red on the sunny side, of fair to good quality. Middle of August.

Summer Pearmain.—A valuable dessert apple ripening in September. Size medium, oblong, slightly conical; color yellow, shaded and streaked with red; quality best. The tree is vigorous and bears young.

Summer Rose.—A handsome little dessert apple ripening in August. Color greenish white shaded with bright red. Valuable for home planting.

Titovka.—A very large, beautifully colored apple ripening in August and keeping until about the middle of September. The tree is rather a poor grower and doubtless the variety would succeed best top-worked on some strong growing kind. Promising for market.

Walker.—A medium to large greenish yellow apple, splashed and washed with red on the sunny side. Of very firm texture and a long keeper. An old variety from Georgia. December to April.

Watermelon.—A peculiar, spreading, crooked growing tree, with a very open top and large leathery leaves. The fruit is rather soft and only fair quality. Color greenish white, washed and striped with light red on the sunny side. Of doubtful value. August.

Wealthy.—Tree moderately vigorous, with a roundish head; an early and abundant bearer. Fruit large, roundish oblate; color pale yellow mostly overspread with dark red. A valuable fall market variety. Ripe in September and keeps several weeks.

Whinery.—A winter apple of medium size and good quality. Color light yellow shaded with red. Trees young and unproductive as yet. December to April.

Winter Streifling.—A large fall apple, whitish yellow in color, with splashes and stripes of red. The tree is vigorous and bears heavy crops annually. September.

Yellow Transparent.—An early Russian variety valuable for home planting. Size medium, roundish, remotely conical; color clear light yellow; texture tender, juicy; quality good. August.

Zolotoreff.—An open grower with fruit well exposed to view, fairly vigorous. Fruit large, roundish; color pale yellow, shaded, splashed and striped with light and dark red; quality fair. August.

CRAB APPLES.

August.—Size very large for a crab apple; color yellow, washed and striped with red; texture crisp; tender; quality fair. The tree is a fairly vigorous grower with roundish head. Not considered valuable.

Dartmouth.—Size medium, oblate; color bright dark red; texture crisp; quality very good. Does not equal Hyslop, which variety it somewhat resembles.

Excelsior.—Above medium in size, handsomely colored, of good quality. Should take well in market, but is a trifle tender and requires careful handling. The tree is an upright vigorous grower and an abundant bearer.

Florence.—Received from Stark Bros. The tree is an upright spreading grower of moderate vigor and enormously productive. Fruit small, oblate; color clear yellow, striped with light red, good quality. Inclined to overbear and much of the fruit is undersized and imperfect as a result of this tendency.

TABULATION OF CRAB APPLES, 1900.

(Pyrus baccata; including actual and supposed hybrids.)

Abbreviations: Month—e, early; m, middle; l, late. Form—c, conical; i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. Color—g, green; r, red; ru, russet; w, white; y, yellow. Texture—c, crisp; d, dry; f, firm; j, juicy; t, tender. Flavor—a, acid; m, mild. Use—d, dessert; k, kitchen; m, market.

Name.	Planted.	Vigor.	Bloomed.	Product.	Season.	Weight in oz.	Form.	Color.	Texture.	Flavor.	Quality.	Use.
August	1890	8	May 14	4	Aug. Sept.	4.8	r c	y r	c t	a	4	k
Dartmouth	1890	10	" 14	3	Sept.	2.2	r	r	c	a	9	k m
Excelsior	1890	9	" 14	10	Aug. Sept.	4.4	r o	y r	t	a	6	k m
Florence	1890	8	" 14	10	Sept.	1	o	y r w	t c	a	6	k
Gibb	1890	8	" 14	10	Aug.	1.8	o	y	c	a	2	......
Martha	1890	8	" 16	7	Sept.	2.2	o	y r	t	m	7	k m
North Star	1890	8	" 15	7	Aug.	1.2	r o	y r	t	m	4	k
No. 1 New	1890	10	" 14	7	Aug.	5	r	g y r	c t	a	7	d k m
No. 2 New	1890	7	" 14	10	Sept.	3.4	o c	y r	t	a	5	m
Quaker	1891	10	" 15	2	Oct. Nov.	2.5	r ob	y r	c	m	3	......
Whitney	1890	10	" 14	8	Aug.	2.4	r	y r	c	a	8	k m

Gibb.—Of medium size, pale yellow, poor in quality. Worthless here. August.

Martha.—Size medium, oblate; color yellow well overspread with bright red; quality very good. Tree upright, spreading, vigorous, and moderately productive. Late August and early September.

North Star.—Pale yellow, nearly overspread with bright red in the sun. Resembles Transcendent in texture and flavor. Apt to be small and inferior. August.

No. 1 New.—Although a crab seedling, appearances would place this variety with the apples rather than with the crabs. Resembles Duchess closely in tree and somewhat in fruit. Ripens about a week later than Oldenburg, and would seem to be a valuable variety to follow it for market. Very good for culinary purposes, but too brisk for eating uncooked. A little tender and requires careful handling.

No. 2 New.—Like No. 1 New this variety resembles the apple rather than the crab. Of medium size, greenish yellow shaded with red. The tree is a good grower and an abundant bearer.

October.—Small, yellow, shaded with red, of poor quality. Subject to dark leathery spots beneath the skin. Worthless here.

Quaker.—A handsome upright spreading grower but a very shy bearer. The fruit is yellow with brownish red cheek. October to November.

Virginia.—Size medium, roundish; color light red turning a shade darker in the sun; quality very good. The tree is an upright spreading grower, with stout reddish brown shoots. Late September.

Whitney.—Medium to large, smooth and perfect in form; color dark red on yellowish ground, handsome; texture crisp; flavor mild, sprightly, sub-acid; quality very good. The tree is an upright vigorous grower and an abundant bearer. A valuable variety.

NUTS.

Six varieties of chestnuts fruited this season. Paragon, one of the best known of the European group, was the most productive. Cosford and Kentish Cob filberts bore quite freely. Of the two varieties Cosford is the hardier and more reliable. The Japan walnut, *Juglans Sciboldii*, sustained its past reputation for heavy bearing. The tree is valuable for ornamental purposes as well as for the nuts which are of quite good quality. The English walnut makes very slow growth. An eleven-year-old tree stands less than five feet in height and shows no signs of fruiting.

CHESTNUTS—EUROPEAN GROUP.

The trees of this group are upright, spreading, strong growers with stout branches and large, thick leathery leaves. The nuts which are of large size and usually of quite good quality, are borne in very large, thick burs.

Comfort.—Planted in 1894. The tree has grown well, but has fruited very sparingly up to the present time. The nuts are as large as Paragon and of good quality.

Numbo.—The poorest grower among the European chestnuts on trial. The nuts are large and sweet. Ripens quite early. Does not give much promise of proving valuable.

Paragon.—A good grower and an abundant bearer. A six-year-old tree this season yielded eight quarts of large sound nuts of good quality. Comes into bearing early and bears regularly. By far the best variety thus far tested either among the European or Japan kinds.

Spanish.—This variety was badly frozen during the winter of 1898-9, and died after producing a small crop of nuts the following autumn. The fact that the tree is tender renders the variety undesirable.

CHESTNUTS—JAPANESE GROUP.

The Japan chestnut is of much more recent introduction than the European having been first imported about 1876, while trees and nuts of the European group were brought to the United States one hundred years ago. The introduction of the Japan chestnut awakened considerable interest in chestnut culture and the varieties which were imported direct, together with a much larger number which are the result of careful selection from thousands of seedlings grown by a number of nurserymen, have been widely disseminated. Nowhere in Michigan have plantings assumed the proportions of commercial orchards as in some of the eastern states, but considerable interest has been manifested and in some instances, at least, should prospects appear sufficiently encouraging, the small plantings with a view to securing a few nuts for home use, would be supplemented by larger plantings for profit. The trees of this group are slow growers of rather dwarfish habit with roundish bushy heads, slender branches, and small, long, narrow leaves. The nuts are large, somewhat inferior to the European in quality, and are borne in rather small thin burs. This group retains its foliage considerably later than the European.

Hale.—One of the three varieties (Coe, Hale and McFarland) owned and propagated by J. H. Hale, South Glastonbury, Conn. The three were selected by Luther Burbank from a lot of ten thousand bearing seedlings raised by him from imported nuts. The Hale bears very young. A tree planted in the spring of '99 this season produced about a dozen perfect nuts. The nuts are large and attractive in appearance and are borne in round thin burs. In quality they are sweet and quite good although inclined to be a trifle dry and starchy. Requires further trial.

Japan Improved.—The trees were planted in 1890 and have grown very slowly. The nuts are of immense size, rather light color, and of good quality. The burs which are round and thin usually contain either one or two nuts. This variety proves to be rather unproductive here.

Reliance—Received from William Parry, of Parry, N. J., in 1899. This season a number of perfect specimens were borne. They are of medium size, quality fair. Has grown very slowly but this may perhaps be attributed in part to its early bearing tendency.

FILBERTS.

Filberts have fruited better here this season than ever before. Ordinarily the catkins have been more or less frozen and but little or no fruit has been produced. They are valuable plants for ornamental purposes and can be expected to produce some fruit under favorable conditions.

Cosford.—A thin shelled variety of best qualtiy. The variety is hardy and is more certain to fruit than Kentish Cob. The nuts are above medium in size, elongated, smooth, and attractive. The plants are a little less thrifty in growth than Kentish Cob.

Kentish Cob—The bush is a very strong grower with large thick leaves. Eight-year-old plants produced about three quarts of nuts each this season. The nuts are very large, at least a half larger than Cosford, elongated, of good quality.

WALNUTS.

Japan Walnuts (*Juglans Sciboldii*).—This variety grows rapidly making a handsome tree for ornamental purposes. The nuts are borne abundantly in large clusters. They are a little smaller than the English walnut which they resemble in shape. The quality is good but not high.

English Walnuts.—The English or Persian walnut grows slowly here. One tree, eleven years old, measures less than five feet in height. It gives no promise of fruiting or becoming in any way valuable here.

S. H. FULTON.

South Haven, Mich., December 13, 1900.

EXPERIMENTS WITH SUGAR BEETS.

BY J. D. TOWAR.

Bulletin 188,—Agricultural Department.

SUMMARY.

1. Clay loam soils produce largest tonnage and highest per cent of sugar.

2. Muck soils may produce beets of a high per cent of sugar, but most pure mucks yield beets showing a per cent of sugar too low to work with profit.

3. Seed planted between May 10 and 25 gave a crop of the largest money value per acre, although any time between the last week in April and the last of May is safe for planting in this latitude.

4. Planting beets three years in succession on the same ground has not yet developed any serious fungus disease nor encouraged the spread of insect enemies.

5. Beets planted in rows 21 inches apart gave 5 per cent greater yield than in rows 18 or 24 inches apart.

The experiments recorded in this bulletin were conducted during the summer of 1900 with soil ranging from sand to loam on the older portion of the College Farm. The ground is high and a considerable distance from the watertable and has not recently been treated with farm manures; many of the plots have produced beets two years in succession and some three years. The reader will find the yields somewhat low, and naturally conclude that the industry is not profitable. It must be remembered that this soil is not adapted to the growing of large crops of beets and the value of these results consists entirely in their relation to each other. The variety test was made on ground which received reasonably good preparation and may serve to give the reader an idea of the probable yield on medium loam, though a heavier soil more favorably located with reference to soil moisture would have given much larger yields. The chemical work connected with this bulletin was done under the direction of Dr. R. C. Kedzie, the chemist of the Experiment Station.

KIND OF SOIL.

Numerous inquiries come to this office relative to the kind of soil best adapted to the growth of sugar beets. While the results thus far obtained throw some light on the subject generally, there is yet a good deal to learn with regard to our Michigan soils for this purpose.

Clay Loam.—In Bulletin 179, p. 107, we published results from 429 different trials wherein the averages show most decidedly in favor of clay loam, which almost invariably gives the highest tonnage with a maximum per cent of sugar.

Muck.—Next in that report to the clay loam, when we consider the money value of the crop, is the so called muck. The figures are somewhat misleading, for the term muck is applied to such a variety of soils, including the deep marsh muck and the swamp, where the subsoil is so near the surface that the beet roots penetrate deeply and enjoy conditions wholly unknown on the muck where it exists in the pure state. For the past two years we have grown beets on some of the College muck land, and under no condition have we yet been able to secure beets that will test 12 per cent sugar.

About thirty samples were this year tested from the Brook Farm of Michigan Asylum for the Insane at Kalamazoo. The soil is from a field adjacent to the celebrated Kalamazoo celery farms and appears to be identical with the celery muck. The highest per cent of sugar obtained was 10.95, the lowest 8.19, and the average 9.40. Highest coefficient of purity is 77.28.

Mr. C. R. Ferguson and Darius Allen, of Almont, have conducted an extensive fertilizer experiment on their large muck farm, growing sugar beets as one of the crops. The average per cent of sugar in the beets was 8.64 (in juice 9.4). Owing to excessive rains the growth was irregular, the stand uneven, and estimates of yield very unsatisfactory and misleading. The beets grown were very short and undesirable for factory purposes. A similar experiment was conducted by Mr. A. M. Todd on his large muck farm near Pearl, Allegan county. Here, as in the Ferguson and Allen experiment, excessive rains in the early life of the beet crop rendered valueless the yields as to tonnage, but the results of analyses promise for this land a profitable per cent of sugar, the lowest being 11.21 per cent, the average of 20 being 12.76, while 6 samples averaged over 14 per cent. The beets were very small, the average weight of the samples tested being only 8 ounces.

Mr. Todd's muck farm lies in the center of a large tract of muck land which, like the Ferguson and Allen muck, is annually producing good crops of mint, oats, barley, corn, and the cultivated grasses, yet it is a deep muck and resembles closely many of the muck lands previously experimented with which gave exceedingly low per cent of sugar.

Clay.—The difficulty with heavy clay land for beets is not so much the natural productive quality of the soil as it is its physical character. The clay soil is always underlaid with a still harder and more impenetrable layer of clay subsoil which must be mellowed by use of the subsoil plow. Even with the best preparation the clay soils are liable to bake hard during the summer and forbid the beets from being drawn well into the ground, thus forming ill-shaped roots growing largely above the ground and containing a low per cent of sugar. If one is to use clay soil for growing beets he must subsoil thoroughly, see that the soil contains a liberal amount of humus and provide generous surface cultivation during the dry summer weather to insure moisture and mellowness.

Sand and sandy loam.—Numerous experiments on these soils reveal the important fact that for a crop so dependent upon a liberal and constant supply of moisture throughout the growing season, they are too liable to fail during the summer drought.

The more sandy a soil the less is its capacity to attract and hold capillary moisture, and the absence of a necessary supply of water during any portion of the life of the plant arrests the growth and a failure of the crop is the result. A large crop of sugar beets taxes the productive capacity of any soil to its limit and the lighter soils generally lack the natural fertility necessary to produce a maximum growth. There is one advantage, however, with the lighter soils which should not be overlooked, and that is the ease with which they are worked. No subsoiling is necessary, and the plowing and nearly every operation, even to the harvesting of the crop, cleaning the beets, and, we may add, the marketing, is performed with greater ease on the lighter soils than on those containing a greater admixture of clay.

So far our experiments with the various soils teach us this, that clay loams will give one year with another the highest yield and the most sugar. The sandy loams will always produce beets of a moderately high per cent of sugar, but a very dry season is liable to check the growth to a disastrous extent. Heavy clays are liable to produce beets of undesirable shape and low in sugar. Sandy soil is almost sure to suffer from summer drought. Muck is very uncertain both as to yield and per cent of sugar, each individual field calling for a special trial before any conclusion as to its adaptability to sugar beet production can be formed.

DATE OF PLANTING.

The ground for this experiment, a light sandy loam, was the same as we employed for a similar experiment conducted one year ago, the results of which are found on page 102 of Bulletin 179. This is the third successive year this ground has produced sugar beets.

The weather conditions for the season were better than usual, the spring opening in time to plant the seed three days earlier than in the previous year, while the rainfall during the summer has provided favorable moisture conditions. There seemed to be nothing in the temperature in any way seriously detrimental to the growth of the sugar beet crop.

The table below gives the results. Kleinwanzlebener seed from Dippe, Germany, U. S. Department of Agriculture No. 3944, was used in this experiment.

Table of results, date of planting.

Date of planting, 1900.	Yield per acre. Lbs.	Analyses.			Price per ton.	Value of crop per acre.
		Per cent of sugar in juice.	Purity.	Per cent of sugar in the beet.		
1 April 19	18,450	13.41	81.32	12.34	$4 61	$42 53
2 " 26	15,950	14.33	86.38	13.18	4 89	39 00
3 May 3	18,630	13.22	84.80	12.16	4 55	42 38
4 " 10	20,870	13.03	79.04	11.99	4 50	46 76
5 " 17	20,220	13.09	77.04	12.04	4 51	45 60
6 " 24	18,970	13.99	79.47	12.87	4 79	45 39
7 " 31	15,640	13.36	78.17	12.29	4 60	35 97
Average	18,390	13.49	80.89	12.41	$4 64	$42 66

The yields are of beets trimmed and cleaned for factory purposes in accordance with the methods employed in the tare room, while the price per ton is calculated on the basis of $4.50 per ton for 12 per cent beets and 33⅓ cents for each additional per cent, allowing 8 per cent marc for impurities in sugar in the juice. The sugar in the beet is determined by multiplying the "sugar in the juice" by 92 per cent.

No explanation for the falling off in yield of plat 2 can be given except that for some unaccountable reason there was not a perfect stand in all the rows. The seed in the May 31st planting did not germinate perfectly, although the beets grew to good size and showed a sugar content almost equal to the average. While the plantings of May 10, 17 and 24 produced the largest yield and highest money value, it does not signify that the earlier plantings are inadvisable. In 1899 the largest yield was from an April 29 planting, while the highest money value resulted from planting May 6. The results from two years' experiments give us a range of practically one month, extending from the last week of April to the last week of May when we plant beet seed and reasonably expect at least a normal yield. Plantings made later than May 25 are somewhat hazardous and may be considered safe only on heavy soils that insure a liberal supply of moisture.

In justice to the sugar beet industry and to ourselves for conducting this experiment, a word explaining why this experiment has been conducted three successive years on this soil so illy adapted to the growth of this crop seems to be advisable. There was a secondary object to determine if possible the danger of developing fungus diseases or encouraging the propagation of insect enemies and the effect on the soil by continued growth of the beet crop on the same ground. So far our observations fail to reveal anything of importance as a result of this practice except a slight decrease in yield. Occasionally there were beets affected with crown gall, illustrated on page 110 of Bulletin 179, but no more so than appeared on some other land that bore its second crop of beets this year. No insect enemies have made their appearance on the college fields to any noticeable extent. The leaf blight was more prevalent on the early planted beets than on those planted at the later dates.

DISTANCE APART OF ROWS.

In connection with an experiment with fertilizers a trial was also made with rows 18, 21 and 24 inches apart. The conditions were such that a very fair trial of these three methods was made. The nature of the soil appeared to favor the 24-inch rows for at one end of the field that part of the experiment was on ground slightly lower and richer. About one acre of land was devoted to the 18-inch rows and a half acre to each of the others.

The results below are computed to acre areas:

Rows 18 inches apart yielded 22,109 pounds beets per acre.
Rows 21 inches apart yielded 23,271 pounds beets per acre.
Rows 24 inches apart yielded 22,119 pounds beets per acre.

In no case were the beets too large, while with the 18-inch rows they were undersized, incurring extra work in harvesting, handling and topping. It may be further argued that the greater distance between the rows the less the work in all the operations connected with growing the crop. The per cent of sugar in the beets was practically the same in each case.

With 18-inch rows it takes 29,040 feet (5½ miles) of row to make an acre; with 21-inch rows, 24891 feet (4 5-7 miles), and with 24-inch rows, 21,780 feet (4⅛ miles). After the ground is prepared, all the operations, such as drilling the seed, thinning, hand and horse cultivation and pulling the beets, are practically in proportion to the length of row in an acre. In strong land, capable of growing a large tonnage of beets, there might be danger of growing beets too large if planted in rows over 18 inches apart, but in loamy and sandy loam soils it seems to be wise to adopt the 21 or 22-inch row.

DO SUGAR BEETS EXHAUST THE SOIL?

This is a question that frequently arises when considering whether to grow sugar beets or not. The direct answer is "yes," the same that one might give in reply to the question were it asked of almost any other crop. In the case of clover, there is so much left in the soil in the form of roots, stubble and leaves that its growth, even though harvested for hay, generally leaves the ground in better condition than before it was grown. Wheat, oats, corn, timothy, beans, peas, millet and in fact all farm products, except perhaps clover, are exhaustive, and their continued production year after year on the same ground will eventually result in complete loss of fertility.

How exhaustive, then, is the sugar beet crop, and is it more exhaustive than any other crop, are the questions that naturally follow. Two experiments the past season give us results suggesting a reply, one in connection with the soil test experiment on the College Farm and the other with a similar experiment on the farm of L. B. Walton, Dryden, Mich. The soil on the College experiment was a loam and so far as the comparison is concerned was very uniform. In 1899 a strip 2 rods wide running across the 13 plots of the soil test experiment, making a strip 2 rods by 26 rods, was sown to sugar beets; an adjoining strip of the same size was planted to potatoes. In 1900 the 2-rod strip, occupying one-half of the potato ground and one-half of the beet ground of the former year, was devoted to the beet crop. Aside from the fact that one strip grew beets last year and received then the cultivation required for sugar beets, and the other grew potatoes with normal potato culture, the other conditions, such as fertilization, character of the soil, previous treatment and management, this year were exactly the same. It was observed all during the fall growth that the beets on the ground that produced beets the previous year were much inferior to those grown on ground raising beets for the first time.

In the experiment on Mr. L. B. Walton's farm in Lapeer county, a similar condition existed. The soil, a clay loam, was extremely uniform in character. In 1899 one-half the area was planted to beans and the other half to sugar beets. Below is the table of the results:

College farm experiment.			L. B. Walton experiment.		
Crop previous year.	Average yield per row.	Com. yield per acre.	Crop previous year.	Average yield per row.	Com. yield per acre.
Potatoes	349½	23,658	Beans	782	29,145
Sugar beets	320	21,662	Sugar beets	646	23,998
In favor of potatoes	29½	1,996	In favor of beans	136	5,147

In each of the above experiments the tops were left on the ground. While this result is in no way conclusive, it indicates that sugar beets on even strong land are more exhaustive than potatoes or beans. Several experiments (on the College Farm) have been conducted during the past year on the same soil where they were in progress one year ago. While a few, in the variety test in particular, were on soil growing beets this year for the first time. In no case did the soil which produced beets two years in succession, even though much better fertilized, produce yields as high as the soil growing beets this year for the first time. It has been said that sugar contains none of the elements supposed to contribute directly to soil fertility, and were the refuse of the beet factory returned to the farm there need be no serious soil exhaustion. An experiment was begun this year in a small way to determine the value of this material in maintaining the fertility of the land.

Plots of 1-44 acre each of sandy soil were selected for this work. The ground had produced beets the previous year and was of such a character that only slight yields could be expected. Unfortunately, the land available for this work left none for an untreated plot after the several materials were applied. We did apply air-slaked lime to compare with the sugar house lime, and noted that the latter was so wet and lumpy that a satisfactory incorporation with the soil could not be secured. The results too are for such small area and the coefficient of error is so large that calculations for field areas are only indicative and should be regarded as such.

Table showing results from factory refuse used as a fertilizer.

Materials applied on 1-44 acre plots.	Yield per plot 1-44 acre. Lbs.	Computed yield per acre. Tons.	Analyses.			Sugar per acre. Lbs.
			Weight of beets. Ounces.	Per cent of sugar in juice.	Purity.	
Sugar factory lime, 200 lbs	406	8.93	11½	14.39	82.28	2571
Air-slaked lime, 100 lbs	463¾	10.20	15	14.22	85.17	2902
Beet pulp, 2 bbls	497	10.93	13¾	12.33	76.63	2696
Refuse molasses, 15 gals	628¾	13.83	14	12.80	78.58	3541

As noted above, the sugar factory lime could not be satisfactorily applied, and the results in all probability are not what they would have been had the material been applied in a pulverized form and well worked into the soil. In bulk practically the same quantity of each form of lime was used.

Throughout the growing season the beets on the molasses plot were decidedly the best, while the differences among the others were so slight as to be unnoticed.

The results here obtained, while unsatisfactory and inconclusive, are yet of significance enough to demand further experimentation along this line. The application of any one of these materials is, at most, only a partial supply of elements needed to maintain soil fertility. All three might come nearer to furnishing a "balanced ration," while the addition of some one or two elements from another source might result in a complete fertilizer of great economic value.

Below is the analysis of the materials used in this experiment as reported by the chemist of the Michigan Experiment Station:

	Lime cake.	Molasses.	Beet pulp.
Ammonia	.18	1.49	.24
Phosphoric acid	.35	.027	.045
Potash	.28	2.43	.084
Lime (Ca O)	22.47		

TEST OF VARIETIES.

Fourteen varieties of sugar beet seed were tested the past season, giving yields and analyses as recorded in table below. The seed of the several varieties came to the Experiment Station through the United States Department of Agriculture at Washington, and American agents for sugar beet seed. The ground, a sandy loam, was plowed and subsoiled one week before sowing the seed and given good preparation for seeding by thoroughly rolling and harrowing. Unleached hardwood ashes analyzing 1.51 per cent phosphoric acid and 6.49 per cent potash were applied on the ground before seeding and thoroughly harrowed in at the rate of 2,000 pounds per acre. After the beets were thinned nitrate of soda was sown at the rate of 110 pounds per acre between the rows and mixed into the soil with a hand cultivator. The crop received only usual care. The seed was sown April 28 in drills 18 inches apart.

Variety test of beets, Michigan Experiment Station, 1900.

Variety.	Seed test from 100 seed balls.			Average distance apart in the row. Inches.	Yield per acre. Tons.	Average weight of samples analysed. Oz.	Per cent of sugar in the juice.	Purity.	Sugar in the beet.	Price of beets per ton.	Value of crop per acre.
	No. sprouts at the end of 1 week.	No. sprouts at the end of 2 weeks.	Seed balls that did not grow.								
B. G. V. White Improved Vilmorin	85	166	52	7	15.53	12	14.18	82.59	13.05	$4 85	$75 32
Austrian Special Kl. No. 8	122	150	30	6+	15.21	12	13.61	79.27	12.52	4 67	71 03
" " " No. 5	155	175	25	6—	16.29	12	14.03	80.77	12.91	4 80	78 19
Licht Kl	125	167	28	7—	14.11	12	13.06	79.78	12.02	4 51	63 63
Ziemann Kl	115	211	9	8—	14.96	13	13.06	78.82	12.02	4 51	67 47
Kl. Govt. Seed 3944	144	184	28	6+	14.32	14	13.44	83.12	12.36	4 62	66 16
Zeh. " " 3942	66	66	64	7—	14.38	12	14.48	82.41	13.32	4 94	68 04
Vil. " " 3941	77	183	51	6+	*10.87	11	14.19	84.62	13.05	4 85	52 72
Kl. from D. M. Ferry & Co	209	209	3	6+	13.12	11	15.63	84.17	14.37	5 29	69 40
Russia 1 Govt. seed 3943	144	201	00	7—	12.99	14	11.87	77.23	10.92	4 10	53 26
" 2 " " 4416	226	237	00	6—	12.13	12	13.40	77.14	12.33	4 61	55 92
Mangold	110	150	38	7—	13.82	11	13.73	84.91	12.63	4 71	65 09
Simon Le Grande B 12	87	184	13	7—	15.08	12	13.19	80.57	12.13	4 54	68 46
" " " C 27	33	126	28	7—	15.74	13	13.58	80.98	12.50	4 67	73 51
B. G. V. White Improved Vilmorin	85	166	52	6+	12.60	14	12.98	81.67	11.94	4 48	56 45
Average	119	169	27	6½	14.08	12.3	13.63	81.30	12.54	$4 68	$65 89

* An old dead furrow occurred in the middle of this plot.

The above figures represent the actual yield after trimming and computing dockage. All the beets grown on the College Farm are fed to the College stock. The bulk of the crop is trimmed only to the extent of removing the leaves. We, however, make dockage records with every separate lot of beets with which experiments are made. Beets as they go into our root cellars give a dockage of from ten to fifteen per cent when trimmed for the factory, while these beets trimmed in the field for factory purposes show only two per cent dockage when carefully cleaned and trimmed as it is done in determining tare at the factory.

The first three columns of the table above give the results of the germination and vitality tests made by Prof. C. F. Wheeler and his class in sugar beet culture. One hundred seed balls were used in each test. The first column gives the number of sprouts appearing at the end of seven days, and serves as an index to the vitality and vigor of the seeds. The second column includes the first, together with the additional sprouts that appeared the second week of the test. The third column may be used to indicate the per cent of worthless seeds in each sample as it represents the number of bad seeds in a hundred. The Austrian Special B. G. V. grew 166 sprouts from 48 seed balls, nearly three and a half sprouts to each ball, while the Simon LeGrande C. 27 produced only 126 sprouts from 72 balls, or an average of one and three-fourths sprouts to each ball. The low germination does not seem to affect the yield, for the best yielding varieties are by no means those which gave the highest percentage of germination. This is probably due to the fact that enough seed is sown—fifteen pounds per acre—to insure a perfect stand, even though a large percentage of seed failed to germinate.

Taking the above average yield for 14.08 tons per acre and the average per cent of sugar in the juice, 13.63, the method of computing the money value of an acre of these beets at the factory is as follows, assuming that the factory pays $4.50 per ton for 12 per cent beets and 33⅓ cents per ton for each per cent above 12, the computation will be like this.

Marc, analogous to the apple pomace left in making cider, is the insoluble material left behind when all the soluble material is taken out and must be deducted from the per cent of sugar in the juice to determine the per cent of sugar in the beet. Most of the Michigan factories have fixed the marc at 8 per cent.

13.63	13.63	or	100	13.63
.08	1.09		08	92
1.0904	12.54		92	2726
				12267
				12.5396

Thus, after removing the marc of 8 per cent, we find the actual sugar in the beets to be 12.54 per cent. The 12 per cent is worth $4.50 and the $.54\times 33\frac{1}{3}=\$0.18+\$4.50=\$4.68$, the price per ton. Therefore, the 14.08 tons per acre, at $4.68 per ton, are worth $65.89.

EXPERIMENTS WITH SUNDRY FERTILIZERS.

Looking to solution of the problem of what is the practical value of our more common fertilizing materials in their relation to the sugar beet crop, the following experiment was begun in 1899. While the general table below gives us a plain comparison of the effects of the several materials applied, it also supplies results which may be used in connection with the results secured from like treatments on other soils and conditions.

The soil was a medium loam, though not what would be considered strong land, nor best adapted to the sugar beet crop. The fertilizers applied this year were practically the same in quantity and quality as were used the previous year.

The results are shown in the table below:

Experiments with sundry fertilizers.

No.	Fertilizers.		Yield per acre. Tons.	Per cent of sugar in the beet.	Value of beets per ton.	Value of product per acre.	Cost of fertilizer per acre.	Money gain (+) or loss—, from using fertil'zrs
	Materials applied.	Total amount per acre.						
1	Stable manure applied in the winter.	10 loads	13 83	10.80	$4 05	$56 01	$5 00	$+9 91
2	Commercial fertilizer	480 lbs.	9.42	12.63	4 71	44 37	6 25	—2 98
3	Commercial fertilizer Air-slaked lime	480 lbs. 1 ton.	10.53	11.61	4 35	45 81	8 25	—3 54
4	Nothing		9.32	13.01	4 84	45 10	00	....
5	Home mixed fertilizer (Nitrogen in form of N. soda)	480 lbs.	10.27	13.83	5 11	52 48	4 48	+6 90
6	Same as 5 and 1 ton air-slaked lime	480 lbs. 1 ton.	11.59	12.14	4 55	52 73	6 48	—5 15
7	Home mixed fertilizer (Nitrogen in form of sulph. ammonia)	455 lbs.	10.13	14.06	5 19	52 57	4 63	+7 00
8	Same as 7 and 1 ton air-slaked lime	455 lbs. 1 ton.	9.71	12.84	4 78	46 41	6 63	—1 33
9	Nothing		8.18	13.18	4 89	40	00	....
10	Dissolved phosphate rock, 250 lbs. Muriate of potash, 250 lbs.	500 lbs.	9.76	11.32	4 25	41 48	7 93	—7 55
11	Nitrate of soda	250 lbs.	9.65	12.24	4 58	43 20	6 25	—4 15
12	Sulphate of ammonia	190 lbs.	8.68	12.66	4 72	40 97	6 65	—6 78
13	Air-slaked lime	1 ton.	9.00	12.47	4 66	41 94	2 00	—1 16
14	Nothing		8.23	13.27	4 92	40 49	00	......
15	Same as No. 10	500 lbs.	8.79	14 19	5 23	45 97	7 93	—3 06
16	Sulphate of potash	500 lbs.	9.01	12.16	4 55	41 00	12 50	—12 60
17	Stable manure applied just before seeding	10 loads.	10.54	12 24	4 58	48 27	5 00	+2 17
18	Nothing		8.31	12.52	4 67	38 81	00	......
19	Wood ashes	2,000 lbs.	9.56	13.27	4 92	47 04	5 00	+ 94
20	H. M. fertilizer	500 "	9.23	12.26	4 59	42 37	4 55	—3 28
21	Commercial fertilizer	500 "	8.79	13.42	4 97	43 69	5 87	—3 28
22	Salt	500 "	9.54	13.11	4 87	46 45	1 67	+4 18
	Average of nothing plots	....	8.51	....	$4 83	$41 10	....	....

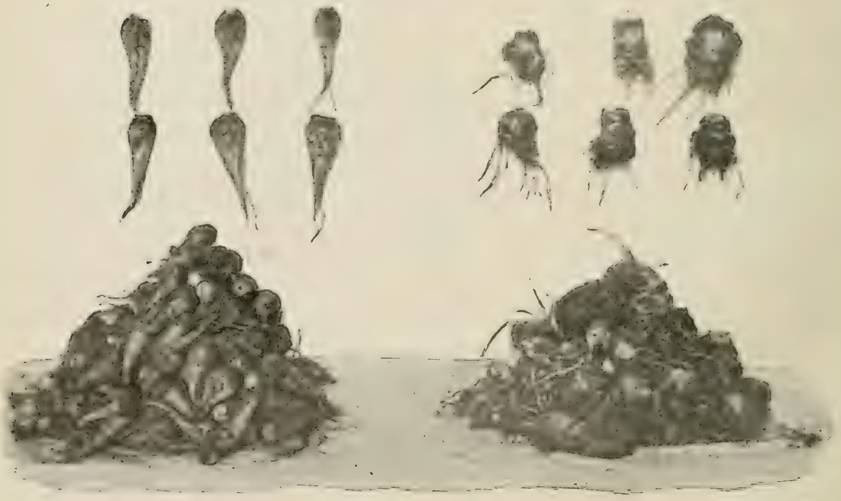
Upon examining the above table we observe that stable manure applied early in the winter gave the largest tonnage of beets, likewise the lowest per cent of sugar, but even then the market price of the product per acre is over $3.00 more than that of any other plot. The application of stable manure made the day prior to plowing the field resulted in a yield third in rank, but as the per cent of sugar is correspondingly low, the money value of the product is brought under that of the home mixed fertilizers.

There is much significance in the results from applying incomplete fertilizers, notably plots 10, 11, 12, 13, 15 and 16. But for the accidental high per cent of sugar in 16, the money value results of these applications would have remained near the mark fixed by the average of the nothing plots. In no case is the increased yield commensurate with the increased cost of the fertilizer applied.

Below is the analysis and cost per ton of the fertilizers employed in the experiments in this bulletin:

Nitrate of soda (18.71% ammonia)		$50 00
Sulphate of potash (49.10% K_2O)		50 00
Muriate of potash (49.85% K_2O)		50 00
Dissolved phosphate rock	available P_2O_5 15.85% insoluble P_2O_5 1.82% total P_2O_5 17.67%	15 00
Sulphate of ammonia (25.38% ammonia)		70 00
Commercial fertilizer	2.59% ammonia 11.83 P_2O_5 6.60 K_2O	25 00
Wood ashes	P_2O_5 1.51% K_2O 6.49%	5 00

RESULTS FROM TRANSPLANTING.



Drilled Beets—Yield, 15,972 pounds per acre; % sugar, 13.16; purity, 81.38.

Transplanted Beets—Yield, 12,124 pounds per acre; % sugar, 10.21; purity, 74.69.

Table showing temperature, amount of rainfall, and per cent of clouds, from April 1 to November 1, 1900.

Day of month.	April.			May.			June.			July.			August.			September.			October.		
	Temp.	Rain fall.	Clouds, %.	Temp.	Rain fall.	Clouds, %.	Temp.	Rain fall.	Clouds, %.	Temp.	Rain fall.	Clouds, %.	Temp.	Rain fall.	Clouds, %.	Temp.	Rain fall.	Clouds, %.	Temp.	Rain fall.	Clouds, %.
1	42⅓	......	50	55⅔	......	00	66	45	100	66	......	......	63⅔	10	05	78⅓	......	......	55⅓	......	......
2	38⅔	34	30	58	12	70	57⅔	......	80	70⅓	23	70	65⅓	01	60	77	05	20	68	......	60
3	36	04	70	39	......	60	61	......	......	70⅓	11	60	70⅓	......	......	66⅔	21	10	69	......	40
4	35	......	00	36⅔	13	50	64⅓	......	......	80⅓	......	......	77	......	......	67⅔	......	......	70⅓	......	......
5	42	......	00	46	......	00	69⅔	......	......	84⅓	......	30	82⅓	......	05	75⅔	......	20	71⅔	......	50
6	57⅔	......	40	53⅔	......	10	71⅓	03	80	80⅔	......	10	80	......	......	78⅓	01	10	75⅔	......	70
7	57⅓	......	00	61⅔	10	40	71⅔	77	80	71	71	100	79⅓	......	10	67⅓	......	......	57	1.11	100
8	41⅓	......	30	58⅔	1.35	95	63⅔	02	10	61⅔	09	100	79⅔	......	......	70	......	30	51⅓	......	100
9	32⅔	......	10	44⅔	......	00	65⅓	......	......	60⅔	......	10	80⅔	......	10	73	......	40	46⅓	......	40
10	32	......	20	52⅔	......	70	72⅔	35	40	68	06	80	81	......	05	76⅓	......	50	48⅓	......	......
11	33	36	10	60⅓	11	80	64⅓	......	10	66⅔	10	40	82⅔	20	40	80	......	50	50⅔	......	......
12	32⅓	05	10	65⅓	15	60	61⅔	......	10	63⅔	......	......	74	17	90	64⅔	......	10	52⅓	......	10
13	35⅓	06	90	71⅔	......	00	63⅔	04	80	67	......	10	66⅔	......	20	64	......	......	54⅓	......	10
14	43	......	10	73⅓	......	30	66	......	20	75	17	60	70⅔	01	40	64⅔	......	......	54⅓	......	......
15	52	......	90	71⅔	......	20	65⅔	......	......	82⅓	......	10	69	13	90	71	......	10	55⅓	02	......
16	55⅔	07	100	67⅔	02	80	68	......	......	76	19	90	72	......	60	50⅔	02	100	42⅔	......	10
17	55⅓	39	100	56⅓	02	80	68⅔	......	......	70⅔	81	100	74⅔	......	30	47⅔	......	90	39⅔	......	......
18	51⅓	02	100	50⅓	06	100	64	......	05	67⅔	......	05	78⅓	......	20	56	02	30	57⅓	......	30
19	53	05	00	54	......	00	62⅔	......	......	73⅓	......	20	80	21	40	57⅔	16	100	48⅔	......	......
20	58⅓	18	10	56⅔	......	00	70	......	......	71⅔	10	70	79	38	30	64	02	60	53	......	30
21	54⅓	44	100	57⅓	......	00	71⅔	......	60	66⅓	......	......	69⅓	......	60	54	......	60	61	08	30
22	53⅔	......	90	60⅓	......	00	66	34	70	72	......	......	70⅔	......	20	58⅓	02	20	64⅓	......	90
23	57	......	50	66⅓	......	70	70	......	......	75⅓	......	60	73⅔	16	90	57⅓	......	10	56⅓	20	60
24	55	......	00	67⅓	......	80	73	......	......	66⅔	1.58	100	75⅓	28	50	61⅔	......	70	59⅓	......	50
25	54⅔	......	00	69⅓	......	20	79	......	......	69⅓	......	30	74⅔	96	05	79	......	......	61	......	......
26	58⅓	......	00	70⅔	......	70	79⅓	......	10	60⅔	......	......	73	31	40	73⅓	......	40	59	......	30
27	60	......	00	66⅓	65	80	76	07	50	64	......	......	69⅔	03	30	55	......	90	49⅔	......	100
28	63⅔	......	00	65⅓	1.30	60	71⅔	......	......	68	......	......	71⅓	09	30	57⅔	30	70	56⅓	......	20
29	64⅔	......	00	65⅔	......	70	63⅓	......	......	74	......	40	70⅓	......	......	57⅓	......	80	63⅓	1.25	100
30	52	......	00	70⅔	......	40	60	......	......	68	......	......	70⅔	......	......	55	......	......	60⅓	11	100
31	......	......	......	67⅓	16	100	......	......	......	73⅓	......	......	72⅓	......	......	......	......	......	67⅓	......	......
Total	......	2.0	......	......	4.17	......	......	2.57	......	......	4.15	......	......	2.98	......	......	.81	......	......	2.77	......
Mean Temp.	48.43	......	......	60.01	......	......	67.59	......	......	70.72	......	......	74.05	......	......	65.31	......	......	57.12	......	......

NOTES ON STRAWBERRIES.

BY L. R. TAFT AND M. L. DEAN.

Bulletin 189,—Horticultural Department.

The strawberries fruited in 1900 were for the most part planted in the spring of 1899, but many of the varieties were in another plantation started in 1898, and the behavior of these kinds was observed on the two-year-old as well as on the young plantation. All of the plants were set out in rows four feet apart and about one and one-half feet apart in the rows, forty feet being used for twenty-five plants, which was the number used for the test in most cases. The soil, although the best available, was not well adapted for strawberries, as there was a shallow stratum of quick-sand within less than two feet of the surface. It is a rather heavy soil containing a considerable amount of clay, and has been top-dressed each year with stable manure, but the plants suffered somewhat from a surplus of water during the spring and from drought during the summer and the stand secured was not satisfactory. A portion of the plants were grown in hills, while the others were allowed to form a narrow matted row.

While the plants were in blossom some injury was done by frost. The loss was greatest to the varieties where the flowers were not protected by the foliage, and whose petals were open. As a rule only one flower upon a fruit stalk was affected. The extent of the injury is shown in the following table.

The plants were cared for, during the season of 1900, by Robert S. Northrop, a student in the class of 1901, and the notes were taken by him under the direction of Mr. M. L. Dean, assistant in the department.

NOTES ON VARIETIES.

BY R. S. NORTHROP.

Big Ben.—Has a perfect flower and vines of weak growth; are not very productive, berries being scattering, but have good color and flavor. In form are round conical, with bright dark crimson color, medium to small in size.

Big Berry.—Perfect flower. Vines are very strong growers, foliage rank and thrifty, of good color and quite healthy. Runners numerous. Fruit stems are few and are thinly set with berries. The fruit is large and of good flavor, irregular conical in form and dark scarlet color. The variety has considerable merit, but lacks in productiveness.

Buoy.—Vines are small, weak growers with but few runners. The foliage is large and coarse, subject to blight. Fruit stems few and poorly filled. Berries are large, dark red, rather soft and of good flavor. Of no value.

Cinda.—Perfect flower. Vines very susceptible to leaf blight. Are small, weak growers, with few runners and fruit stems. Berries are smooth, of dark color and good form, but lack in flavor.

Clarence.—Perfect flower. Vines are strong and thrifty growers, with numerous runners. Are slightly affected by blight. The fruit stems are few and poorly filled with berries. Fruit is of medium size, irregular, long conical and with a long neck. Color dark red. Quality quite good. This variety is a good grower but lacks in productiveness.

Collingwood.—Perfect flower. Plants lack in vigor. Foliage is rather small and light colored. Runners are numerous but the fruit stems few. These, however, are well set with berries. Fruit is rough and irregular in shape, showing poor fertilization.

Color is a bright crimson. Quality very good. The variety is too unproductive to be of value.

Delaware.—Perfect flower. Vines are strong growers and hardy, quite low and short. Runners are numerous as are also the fruit stems, which are quite thickly set with berries. Fruit is of good size, broad conical in shape and bright red color; is thickly covered with seed. Quality rather poor.

Dole.—Imperfect flower. Vines lack in hardiness. They seem to be rank and strong but winter kill badly. Foliage large and coarse. Practically free from rust. Fruit stems and runners are not very numerous. Stems were thinly set with berries, which were rather small and irregular; color quite dark. Blossoms did not set well and productiveness very poor. Is not desirable.

Echo.—Perfect flower. Vines very thrifty, strong growers and hardy, quite well set with runners and fruit stems. Prolific bearers. Berries are medium to large in size, round conical in form, light colored, firm and of a pleasant flavor. A promising variety.

Elba.—Perfect flower. Quite early. Seems to be hardy and vigorous, with sufficient runners but shy of fruit stems and berries. Fruit is round conical in shape, having a neck of medium length. Color is good but the quality is inferior. Not of special value.

Emma.—Perfect flower. Very strong thrifty growers. Hardy, with large, rank and dark colored foliage. Runners and fruit stems are numerous, but the stems are not well set with berries. Fruit is of medium size, good form, color and quality, quite firm and solid. This variety shows considerable promise.

Gamage.—Imperfect flower. Plants vigorous and hardy, with dark colored, healthy foliage. Runners and fruit stems not sufficiently numerous. Stems well filled with berries, which are of good size, somewhat irregular in shape and bright red in color. Quality and firmness fair. A promising variety.

Gladstone.—Perfect flower. Vines thrifty and hardy. Foliage well colored and seems to be resistant to disease. Runners and fruit stems numerous. Berries did not set well, were large, light colored and of irregular form, mostly broad and flat. Of fair promise but somewhat soft.

Glauer.—Imperfect flower. Vines are fairly vigorous, although not as strong growers as some. Runners and fruit stems numerous, and very well set with berries, making a very prolific variety. Berries are round conical, firm and a little acid. Is worthy of trial.

H. and H.—Imperfect flower. Vines seem to be hardy and are vigorous growers, well set with fruit stems filled with berries. The fruit is of good size, quite firm, a little irregular in form; color is a dark crimson. Has a very decided flavor, but is a little acid. Well worthy of trial.

Johnson Early.—Perfect flower. Vines very vigorous and hardy. Runners and fruit stems are numerous. Berries are of medium size, rather dark colored and a little irregular, but approaching round conical in form. The flesh is of soft texture and has a core, is bright red in color and of good flavor. Is a good early berry.

Kevitt Best.—Perfect flower. A small weak grower and lacking in productiveness. Berries light colored, small and acid. Of no value.

Lehman No. 2.—Perfect flower. Vines not very vigorous or hardy, but healthy, and only moderately productive. Berries somewhat imperfect and of but fair quality.

No. 7.—Imperfect flower. Vines fairly strong and vigorous. Fruit stems numerous, very strong and upright, but poorly filled with fruit. Runners strong. Berries light red, medium in size, round and regular in form and somewhat lacking in flavor.

Parker Earle Improved.—Perfect flower. No great improvement noticeable. Vines are slightly lacking in vigor, but are very prolific. Berries are long, round conical, color is dark crimson, quality is rather acid. Almost too prolific for ordinary care. The plants need high cultivation to develop the large number of fruits.

Reed Prolific.—Perfect flower. Vines slightly lacking in vigor and hardiness and subject to blight. Runners very numerous. Fruit stems small, slender and scattering. Berries small to medium, irregular, sour and seedy. Of no value.

Repeater.—Perfect flower. Vines hardy and vigorous, with healthy dark foliage. Fruit stems and runners numerous. Fairly productive. Berries are medium in size, round conical form, bright crimson in color, quite firm and of very good quality, although a little acid.

Roblins Earliest.—Perfect flower. A small grower, vines neither vigorous nor hardy. Fruit stems are scattering, but well filled with small, dark, sweet berries. Not very promising.

STRAWBERRIES, 1900.

ABBREVIATIONS: Sex—perf., perfect; imp., imperfect. Size—l, large; m, medium; s, small. Form—b, broad; c, conical; r, round; l, long; i, irregular; n, necked; d, depressed. Color—b, bright; s, scarlet; r, red; d, dark; v, very; c, crimson; l, light.

Variety.	Sex.	Date of bloom.	Date first ripe.	Date last ripe.	Vigor.	Hardiness of plants.	Bloom killed by frost. %.	Productiveness.	Size.	Form.	Color.	Quality.	Firmness.
Anlo	Imp.	May 15	June 11	July 2	88	85	6	60	l	b c	b s	72	81
Anna Kennedy	Imp.	“ 15	“ 7	June 29	80	90	....	80	s m	r c	v b r	68	76
Arkansas Traveler	Perf.	“ 15	“ 7	July 2	83	95	5	80	m	r c	d r	60	68
Armstrong	Perf.	“ 16	“ 12	June 27	90	80	5	75	l	b c n	b r	77	76
Arnout	Perf.	“ 16	“ 13	July 4	98	90	5	90	m s	l r c	b s	88	91
Arrow	Imp.	“ 15	“ 11	June 25	60	80	....	85	s	r c	......	68	78
Beder Wood	Perf.	“ 11	“ 4	“ 30	100	100	2	90	m	r c	d c	88	84
Big Ben	Perf.	“ 16	“ 14	“ 28	80	85	1	80	s m	r c	b d c	72	74
Big Berry	Perf.	“ 16	“ 14	July 3	94	90	1	85	m l	i c	d s	90	81
Bisel	Perf.	“ 14	“ 9	“ 2	85	90	2	85	m	b c	b r	89	77
Bismarck	Perf.	“ 25	“ 13	June 26	56	85	....	75	m	r c	d r	83	82
Bostonian	Perf	“ 18	“ 13	“ 30	81	90	2	50	l	r c	b l c	82	83
Brandywine	Perf.	“ 14	“ 14	July 5	100	100	2	95	l	b c i	b c	94	89
Brownie	Perf.	“ 18	“ 11	“ 2	95	100	3	60	m l	r c	b s r	92	93
Bryant	Perf.	“ 14	“ 13	“ 8	95	100	2	90	l	b c	v b c	92	92
Bubach	Imp.	“ 14	“ 7	June 30	100	95	....	90	s m	n r c	d r	89	91
Burnett	Perf.	“ 15	“ 11	July 2	91	95	2	75	l	r c	b c	90	91
Clarence	Perf.	“ 21	“ 14	“ 3	88	85	1	80	m	n l c i	d r	89	86
Chenango	Imp.	“ 15	“ 9	“ 2	70	95	....	80	m l	r c	b r	88	76
Cinda	Perf.	“ 18	“ 13	June 30	67	80	2	60	s	r c	b c	72	80
Clyde	Perf.	“ 11	“ 6	July 2	100	100	4	90	m l	r c	b d s	89	92
Cobden Queen	Imp.	“ 15	“ 11	“ 3	100	100	4	85	l	r d c	b r	81	75
Collingwood	Perf.	“ 21	“ 14	“ 2	70	90	2	40	m	r c i	b c	91	90
Crescent	Imp.	“ 11	“ 7	“ 3	95	95	1	80	s	r c	d s	81	84
Darling	Perf.	“ 11	“ 6	June 29	98	100	2	35	s m	r c	b s	68	67
Delaware	Perf.	“ 17	“ 13	July 2	93	95	2	80	l	b c	v b s r	71	79
Dole	Imp.	“ 21	“ 15	“ 2	60	95	...	60	m	r c	b l s	87	85
Dollar	Perf.	“ 17	“ 18	June 29	70	90	....	60	m	i b c	b c	73	79
Drought King	Imp.	“ 12	“ 9	“ 30	100	100	1	85	m	b c	d c	89	81
Echo	Perf.	“ 17	“ 13	July 2	95	100	2	80	m	r c	b s	79	87
Elba	Perf.	“ 8	“ 5	June 29	100	100	1	75	m s	r c n	d c	75	78
Emma	Perf.	“ 14	“ 11	July 6	100	95	2	90	m	l r c	v b c	89	87
Enhance	Perf.	“ 14	“ 9	“ 2	95	95	3	95	m	r c	b c	82	91
Epping	Imp.	“ 15	“ 11	June 30	90	90	8	80	m l	r c	b r	72	76
Evans	Perf.	“ 11	“ 11	“ 30	83	90	2	80	m	r c	b l s	79	80
Excelsior	Perf.	“ 9	“ 4	“ 28	100	100	4	85	s m	r c	b c	90	88
Ey. Jack	Perf.	“ 10	“ 9	July 2	90	95	2	85	m	r c	d s	51	50
Fountain	Perf.	“ 15	“ 12	“ 2	100	100	3	90	l	r c	b s	68	71
Fremont	Perf.	“ 15	“ 14	June 30	100	100	2	70	m l	r c l	d c	74	74
Flash	Perf.	“ 14	“ 11	“ 30	98	100	10	60	l	b c	b s	86	87
Gamage	Imp.	“ 11	“ 11	July 2	93	90	5	90	m	i b c	b r	76	77
Gandy	Perf.	“ 23	“ 9	June 28	88	95	1	90	m l	r c	b s	87	86
Garringer	Perf.	“ 15	“ 14	July 2	75	90	2	75	l	i c	v b c	70	74
Gertrude	Perf	“ 15	“ 11	June 30	90	95	3	30	m s	n r c	b l c	65	76
Giant	Perf.	“ 15	“ 10	July 2	88	85	2	35	m l	r c	b s	65	67
Gladstone	Perf.	“ 17	“ 12	“ 7	100	100	8	....	m	i b c	b s	81	69
Glauer	Imp.	....	“ 11	“ 4	95	95	1	85	m l	i r c	b r	68	75
Glen Mary	Imp.	May 14	“ 7	“ 2	100	100	....	95	l	b c	v b l r	84	78
Greenville	Imp.	“ 15	“ 9	June 30	88	95	1	95	m s	r c d	d c	91	86
H. and H.	Imp.	“ 18	“ 13	July 6	100	95	1	80	m l	b c i	d c	73	76
Haverland	Imp.	“ 11	“ 4	June 30	100	100	....	95	m	r c	b s	87	80
Heffin No. 3	Imp.	“ 14	“ 6	“ 28	98	100	2	95	m l	r c	b c	85	85
Hersey	Perf.	“ 22	“ 11	“ 29	83	85	....	50	s	l c n	b r	75	71
Holland	Imp.	“ 16	“ 9	“ 28	93	100	1	60	m	o	d c	51	84
Homestead	Perf.	“ 15	“ 11	“ 30	95	100	2	80	m	r c	b c	69	66

STRAWBERRIES.—*Continued.*

Variety.	Sex.	Date of bloom.	Date first ripe.	Date last ripe.	Vigor.	Hardiness of plants.	Bloom killed by frost. %	Productiveness.	Size.	Form.	Color.	Quality.	Firmness.
Hood River	Perf.	May 21	June 13	June 29	80	90	4	85	m	r c	b c	63	63
Hoosier	Perf	" 15	" 14	" 25	30	85	3	....	s	r c	r	62	84
Hunn	Imp.	" 21	" 18	July 8	80	85	....	60	m l	b c	b c	71	89
Ideal..................	Perf.	" 23	" 12	June 28	80	65	2	20	m l	b c	b r	55	87
Ima....................	Imp.	" 15	" 14	July 2	90	95	....	65	m s	r c	b s	69	78
Johnson Early.	Perf.	" 14	" 9	June 29	100	100	....	65	m	r c	b r	89	78
Kansas Prolific.......	Perf.	" 14	" 11	July 2	95	90	1	85	m	r c	b c	77	79
Kevitts Best..........	Perf.	" 21	" 13	" 2	75	85	2	80	l	b i	b c	74	76
King Worthy	Perf.	" 17	" 13	June 30	83	95	2	95	l	i c	b s	75	73
Kossuth..............	Perf.	" 14	" 9	July 2	80	85	1	80	m	r c	b s	76	77
Lady Franklin.......	Imp.	" 15	" 11	June 30	95	90	....	70	s m	l c i	b s	79	75
Lady Thompson......	Imp.	" 14	" 5	July 2	100	100	4	80	m	r c	d r	76	80
Lanah..................	Perf.	" 21	" 12	" 2	100	100	1	45	m	r c	b l r	90	81
Lehman No. 2........	Perf.	" 15	" 11	June 29	60	90	....	40	m	b c	d c	69	72
Little No. 7...........	Perf.	" 12	" 13	July 2	88	90	1	80	m s	r c	b r	74	82
Little No. 8...........	Perf.	" 17	" 14	" 2	100	100	1	90	m s	r c n	d s	82	79
Little No. 40.........	Perf.	" 22	" 14	" 3	73	90	1	85	s	r c	b c	76	79
Lovett.................	Imp.	" 11	" 13	" 2	100	100	....	90	m	r c	v b s	87	85
Magoon	Perf.	" 21	....	June 30	78	80	....	20	m l	b i	d c	58	71
Manwell	Perf.	" 21	June 11	July 1	68	85	1	40	l	c i	b c	61	82
Margaret.............	Perf.	" 18	" 12	June 29	88	95	1	60	l	b c	b v d c	77	81
Marshall..............	Perf.	" 17	" 11	July 1	70	90	2	90	l	r c	v d c	90	92
Marston..............	Imp.	" 16	" 5	June 29	83	95	....	30	s m	r c	d c	68	80
McKinley	Perf.	" 12	" 12	" 30	80	80	2	75	m	l c	d c	78	81
Maximus.............	Perf	" 21	" 14	" 29	85	90	2	35	l	l c i	d c	66	81
Mayflower............	Perf.	" 8	" 2	" 29	100	100	3	75	s m	l r c	d r	90	73
Mele	Imp.	" 16	" 12	" 30	83	95	1	70	m l	r c	b r	78	79
Michigan	Perf.	" 18	" 14	" 30	78	85	5	20	l	b i	b r	84	89
Milton	Perf.	" 15	" 13	" 30	78	90	3	65	s	l c	b r	69	77
Morgan Favorite.....	Perf.	" 14	" 10	" 30	100	100	4	85	l	l r c n	b c	89	79
Nick Omer...........	Perf.	" 15	" 13	" 29	78	85	1	75	m l	o	d c	75	74
Nina...................	Perf.	" 15	" 11	July 2	98	95	2	80	m	r c	b s	84	79
No. 7..................	Imp.	" 11	" 9	June 30	90	95	5	55	m	r c	d s	72	84
Ona....................	Imp.	" 15	" 7	" 29	90	85	1	65	s	r c	b r	60	81
Orewiler..............	Perf.	" 14	" 4	" 30	100	90	1	85	m l	o	b r	64	66
Oriole	Imp.	" 15	" 14	" 29	68	90	....	70	m	r c	b c	75	88
Parker Earle	Perf.	" 11	" 12	July 6	85	95	2	85	m l	l r c n	d r	76	76
Parker Earle Imp....	Perf	" 16	" 14	" 2	90	95	2	85	m l	l r c n	b l s	75	74
Parker Earle Jr......	Perf.	" 17	" 14	June 30	60	80	2	80	m	r c	d c	71	77
Peabody	Perf.	" 9	" 4	" 29	98	100	....	95	m	r c	b r	62	50
Phoenix.......... ...	Perf.	" 16	" 7	" 27	85	90	1	85	m l	r c d	b r	71	74
Portage	Perf	" 14	" 13	" 30	93	95	1	75	m l	l r c	b c	60	64
Purdue................	Imp.	" 11	" 5	....	100	95	....	90	l	i c	b c	70	81
Pride of Cumberland	Perf.	" 14	" 12	June 29	93	95	....	85	m l	r c	b c	78	87
Pride of Ohio........	Perf.	" 11	" 5	" 30	90	80	1	75	m s	b c	b c	72	78
Reed Prolific.........	Perf.	" 12	" 11	" 25	90	90	5	55	m s	r c i	b c	65	79
Repeater.............	Perf.	" 9	" 4	" 29	100	95	5	85	m	r c	b c	87	87
Ridgeway	Perf	" 14	" 8	" 28	93	85	1	85	m l	r c	b l c	89	87
Riehl 25-28...........	Perf.	" 14	" 7	" 30	100	100	4	90	m l	b c	b c	84	86
Riehl 29-32...........	Perf.	" 12	" 7	" 30	88	85	4	65	m l	r c	b c	90	65
Rio.....................	Perf	" 11	" 5	" 27	95	100	....	80	m	r	b r	72	77
Ruby..................	Imp.	" 14	" 9	" 29	80	80	1	80	m	r c	v b c	84	73
Roblin Earliest.......	Perf.	" 11	" 4	" 27	75	80	3	60	m s	r c	d r	78	75
Sample...............	Imp.	" 11	" 10	" 30	100	100	....	95	m l	r c	b d c	89	81
Satisfaction..........	Perf.	" 12	" 9	" 28	90	90	2	70	m s	r c	b d c	85	88
Scriver...............	Perf.	" 14	" 7	" 25	88	80	....	45	m	l c n	b c	76	74
See No. 1............	Perf.	" 12	" 5	" 28	90	90	....	80	m s	r c	d b r	85	80
See No. 2............	Imp.	" 16	" 7	" 28	80	90	....	55	m	r c	d b r	80	72
See No. 3............	Imp.	" 16	" 9	" 30	100	95	....	80	l	r c	b r	75	70
See No. 4............	Imp.	" 14	" 9	" 27	80	90	....	80	l	r c	b c	73	80

STRAWBERRIES.—*Concluded.*

Variety.	Sex.	Date of bloom.	Date first ripe.	Date last ripe.	Vigor.	Hardiness of plants.	Bloom killed by frost.	Productiveness.	Size.	Form.	Color.	Quality.	Firmness.
Seek-no-Farther......	Perf.	May 15	June 9	June 29	93	100	...	75	m l	r c	b s	82	79
Seneca Chief.........	Perf.	" 12	" 9	" 29	60	85	....	35	m	r c	d c	69	65
Snowball..............	Perf.	" 18	" 7	" 30	88	90	2	60	m	r c	b s	78	75
Sparta................	Perf.	" 14	" 10	" 30	90	90	....	65	m l	b c	b r	72	90
Splendid	Perf.	" 18	" 9	" 29	70	75	2	35	m	r c	d c	90	77
Star..................	Perf.	" 14	" 14	" 29	60	80	....	30	m	b c	b s	78	69
Stevenson.............	Perf.	" 15	" 8	" 20	70	85	8	20	m s	r c	b l r	75	75
Stone Early...........	Imp.	" 11	" 4	" 30	100	100	....	100	m s	r c	b l r	72	74
Stouffer	Perf.	" 11	" 9	" 28	98	85	....	80	l	l b c	b d c	60	72
Success...............	Perf.	" 15	" 4	" 29	95	100	....	75	m	r c	d c	85	78
Stahelin..............	Perf.	" 14	" 5	" 29	90	90	...	65	m l	r c	b l c	82	74
Surprise..............	Perf.	" 16	" 4	" 30	100	100	....	80	m	r c	b c	73	71
Thompson 103.........	Perf.	" 16	" 12	" 28	85	95	....	25	m l	r c	d c	71	75
Timbrell..............	Imp.	" 16	" 10	July 2	100	95	....	75	m l	r c	d c	64	68
Unnamed	Perf.	" 14	" 9	" 2	100	100	5	50	l	b c	d c	89	78
Vandervort 2..........	Perf.	" 15	" 11	....	88	85	....	85	m l	l r c n	b s	82	83
Vandervort 3..........	Perf.	" 15	" 10	June 29	80	75	....	80	m l	r c	b d s	55	61
Vera	Imp.	" 16	" 7	" 24	78	100	....	30	m	r c	b l r	87	70
Vories................	Perf.	" 14	" 6	" 29	100	100	5	65	m	r c	b s	86	72
Warfield.	Perf.	" 11	" 5	" 29	100	100	....	70	m l	r c	b d r	87	81
Weston................	Imp.	" 16	" 7	" 29	85	85	1	85	m l	b c	d c	87	88
Wetzel................	Perf.	" 16	" 9	" 25	65	90	1	10	m l	r c	b l r	79	76
Whitney	Perf.	" 21	" 14	" 29	50	70	....	25	m	r d	d c	88	84
Wm. Belt	Perf.	" 14	" 11	July 2	90	90	1	75	l	b c i	b r	80	78
Woolverton............	Perf.	" 16	" 7	June 29	78	90	1	40	m	r c	b l c	82	90
Wonderful.............	Imp.	" 16	" 7	" 25	58	90	1	25	...	......	l c	65	68
Wooll	Imp.	" 14	" 5	" 29	85	95	....	45	m	i c	d c	72	76
World Champion.....	Imp.	" 16	" 12	" 25	73	80	....	10	m	b c	b r	53	70
Zula	Perf.	" 21	" 9	" 25	68	90	1	20	m s	r c	b l c	74	68

Stouffer.—Perfect flower. One of the most vigorous growers, free from blight. Runners a little shy; fruit stems numerous, but not well filled. Fruit large, irregular, round or long conical, dark colored, sweet and of good flavor. A promising sort.

Vera.—Imperfect flower. Plants quite weak. Fruit stems plentiful but the berries did not fill well. Fruit dark colored, round conical, somewhat irregular and of very good flavor. This variety was grown under unfavorable conditions, and this undoubtedly had much to do with the poor showing made by it.

Vories.—Perfect flower. Plants vigorous although somewhat subject to blight. Runners and fruit stems are numerous, but the fruit stems are not well filled with berries. Fruit is dark colored, broad conical in form, and of a sweet pleasant flavor. Of some value.

Wonderful.—Imperfect flower. Plants seem to lack hardiness as but few plants grew. Poor showing was probably due to the location.

Wooll.—Imperfect flower. This variety grew under very unfavorable conditions, which must be considered in connection with the accompanying table. Vines are strong growers, dark colored and seem to be a little susceptible to blight. The berries are dark colored, irregular round conical, solid and of good quality. Quite promising.

The following are some of the older sorts which have been described at greater length in previous reports:

Brandywine.—Perfect flower. Vines are vigorous. Fruit is of good size and appearance. Under favorable conditions this is one of the most desirable of the large varieties for general use. Season medium to late.

Beder Wood.—Perfect flower. This variety is much used to fertilize pistillate sorts. Vines are vigorous but somewhat subject to blight. Berries are numerous, a little soft and light colored. Quality good.

Bismarck.—Perfect flower. Plants are of small, low growth. Berries are large in size, dark red in color and of good form. Quality of flesh is very good, firmness medium, a very good variety to grow under high cultivation.

Bryant.—Perfect flower. Plants are strong, healthy growers and quite prolific. Berries are large, broad, conical, of very bright dark crimson color. Flesh is light colored, firm in texture, but lacking some in quality. The general attractiveness of the fruit makes this a desirable market variety.

Bubach.—Plants are vigorous and hardy, especially adapted to strong soils. Berries are good in size, form, color and quality.

Clyde.—Perfect flower. Plants are vigorous and hardy, a little light in color. A very profitable sort on soils not easily affected by drought. Berries are light red, color extending through the berry. Are but moderately firm. Excellent to fertilize pistillate varieties.

Excelsior.—Perfect flower. The plants are very vigorous, hardy, healthy and productive. Runners and fruit stems abundant. The fruit is of medium size, quite firm, dark colored and of good form. Quality is good but acid. One of the best early sorts.

Flash.—Imperfect flower. The vines as grown this year were quite vigorous, with dark foliage somewhat blighted. Runners numerous. Fruit stems slightly lacking in number, but well filled with berries. Fruit is large, of good color and very good quality and texture. Although somewhat lacking in productiveness, it is a valuable variety.

Fountain.—Perfect flower. Tall vigorous plants. Berries are of good size, form and color, and this with its high quality and firmness make it a very good variety.

Gandy.—Vines are fairly vigorous and hardy. Fruit is large, of high quality and firmness. Season late. Only moderately productive, but the variety holds out well.

Glen Mary.—Plants of good growth and healthy. Fruit is borne in abundance, is of large size, of good quality and firmness. One of the best market varieties under high culture.

Greenville.—Plants good in vigor of growth and productiveness. Berries are large in size but not of sufficient firmness. In other points is very good.

Haverland.—This variety is vigorous, hardy and prolific. One of the most profitable for general use. Fruit is of good size and quality. Medium in firmness. Its fine appearance makes it a good market variety, and it is well adapted to the home garden.

Knight.—Vines grow tall but lack in vigor. Foliage is somewhat subject to blight. Berries are of good form, color, quality and texture. This variety seems to be falling off in vigor and productiveness.

Lady Franklin.—Plants are very strong and healthy. Berry is medium to large and of very good color. This variety has very good plants and the fruit is of good quality and appearance, but is lacking in firmness. This makes it undesirable as a market sort, but a very good sort for home use.

Marshall.—This variety is a strong grower and quite prolific. Berries large, dark red and uniform. Quality and texture are very good. Except on strong soil the foliage is slightly subject to blight. This is one of the best large berries upon moist, rich soils.

Morgan Favorite.—Perfect flower. Plants are strong and have very good foliage. Fruit ranks high in size, form and color. The flesh is bright, juicy and of high quality and firmness. The productiveness and uniformity of this variety make it valuable either for home or market use.

Nick Ohmer.—Perfect flower. This variety was in a poor location and for this reason lacked somewhat in vigor and productiveness. Berries are large, of good form and of fine appearance, which, with their high quality and firm texture, should make it a valuable variety.

Ponderosa.—Perfect flower. Plants of medium growth and quite productive. Berries are large and roundish, very good in color, quality and firmness, making it valuable for market and home use.

Ridgeway.—Perfect flower. This variety has very good plant qualities. Fruit is large, of good form and color. The attractive appearance and high quality and firmness make this a very useful variety.

Ruby.—Vines are of medium vigor and healthy in foliage. Fruit stems lacking in number, but well filled with berries. Fruit is medium in size and very good in form, color, quality and firmness. Excellent for home use.

Sample.—Imperfect flower. Plants are strong, vigorous growers, and productive; have stout fruit stalks and large healthy leaves. Berries are of large size, very regular in form, bright dark crimson in color and of high quality and texture. This variety has proved itself valuable during the two seasons grown here. Well worthy of trial.

Timbrell.—Vines are vigorous and of medium productiveness. Berries are large, of good quality, but a little soft. Color is dull crimson, not desirable as a market sort but very good for home use.

Warfield.—Vines are strong vigorous growers and quite productive. Berries are medium in size, of good texture, lacking a little in flavor, but the bright appearance of the berries and their adaptation for canning, make it a very good market variety.

William Belt.—Plants are good growers and productive. Berries are large and of good form; quality and texture are high; color is bright red. This variety was in a poor location which must be considered in connection with the table. A valuable variety.

Several varieties that have stood at the head of the list for a number of years, still maintain their position. Excelsior, Haverland, Warfield, Clyde, Bubach and Brandywine can be relied upon to give good crops under fairly favorable conditions, although the best results cannot be secured with the last three varieties except in rich moist soils. Glen Mary, Wm. Belt, Marshall and Nick Ohmer, also, are quite satisfactory under high culture.

Sample in plant and fruit compares well with any other variety. Morgan, Ponderosa, Ridgeway and Ruby have also been quite satisfactory.

Of the newer sorts that fruited in 1900, H. and H., Echo, Emma, Gamage, Gladstone, Stouffer, Johnson Early and Wooll are most promising.

Agricultural College, Michigan, Feb. 1, 1901.

VEGETABLE NOTES FOR 1900.

BY L. R. TAFT AND M. L. DEAN.

Bulletin 190.—Horticultural Department.

During the past summer a comparative test was made of the new varieties of vegetables and a few of the old sorts, and the results are given in the following pages:

The notes on sweet corn and peas were prepared by C. W. Haven, and those on tomatoes by R. S. Northrop, members of the class of 1901.

BEANS, 1900.

The green and yellow-podded Valentines, Golden and Detroit wax-podded varieties are standard sorts that are familiar to all and need no further descriptions than have been given in our former publications.

The following notes are on novelties and new sorts out in 1900:

BUSH SORTS.

Best of All, from Burpee, is a low, bushy growing sort, very productive of long, slender, round, green, tender pods. It matures early.

Carolina is a small bush lima of good quality. The pods are small and contain one to three beans of good flavor and texture. They are earlier than the larger sorts, but the shyness of bearing is against them.

Fillbasket, from Thorburn, is a wax variety of much promise. The vines grow about ten inches high and are very productive of round, stringless, thick-fleshed, tender, toothsome pods.

Lyonnaise, another variety received from Thorburn, is of high quality. The pods average eight to ten inches in length, are round, dark green, very tender and stringless. The vines are low growing, dark green and very productive.

Saddle Back, from Burpee. The vines are tall, strong growers, densely covered with dark colored foliage: pods are numerous, bright yellow, long, tender and of fine quality. It is one of the most desirable sorts.

Shah, from J. C. Vaughan, is a tall, dark green, strong-growing, very prolific sort. The pods are long, small, nearly round, and often a little tough and stringy. The flavor is good, and if picked when quite small the faults are not objectionable.

Vienna Forcer and White Crystal were received from Thorburn. Vienna Forcer is a light colored, quick-growing sort, but lacks a little in productiveness. The pods are long, a little flat, light green and stringless, but not as tender as some varieties. White Crystal is a low, bushy grower, and very productive. The pods are greenish-white, long, round, very tender, stringless and have a flavor hard to excel. A desirable sort.

BEANS, 1900.

[Planted May 9.]

Varieties.	Seedsmen.	Date of edible maturity.
Best of All	W. A. Burpee	July 6
Black Valentine	Peter Henderson	" 6
Bountiful	Peter Henderson	" 10
Carolina	D. Landreth & Sons	" 5
Challenge	D. M. Ferry Seed Co.	" 2
Davis Wax	D. M. Ferry Seed Co.	" 8
Detroit Wax	D. M. Ferry Seed Co.	" 8
Emperor William	W. W. Rawson & Co.	" 10
Everbearing	W. A. Burpee	" 10
Fillbasket	J. M. Thorburn	" 10
Golden Wax	Peter Henderson	" 20
Jones Stringless	D. M. Ferry Seed Co.	" 14
Longfellow	Peter Henderson	" 10
Lyonnaise	J. M. Thorburn	" 15
Mohawk	D. M. Ferry Seed Co.	" 12
New Bean No. 6	F. B. Mills	" 12
Rogers Wax	H. W. Buckbee	" 6
Royal Corn	Livingston Seed Co.	" 24
Saddle Back	W. A. Burpee	" 12
Shah	J. C. Vaughan	" 20
Valentine Wax	D. M. Ferry Seed Co.	" 6
Vienna Forcer	J. M. Thorburn	" 6
White Crystal	J. M. Thorburn	" 18
Pole Varieties.		
Creaseback	D. Landreth & Sons	" 10
July Runner	J. M. Thorburn	" 14
King of the Garden	Holmes	" 30
Leviathan	Peter Henderson	" 10
Long Podded Ten Weeks	W. W. Rawson & Co.	" 8
Seibert	D. M. Ferry Seed Co.	" 20
Southern Prolific	D. Landreth	" 20
Takvorian	Takvorian	" 24
White Dwarf	D. M. Ferry & Co.	" 18
Willow Leaf	W. A. Burpee	" 20
4352 Sevilla Long Pod	U. S. Dept. from Italy	
4353 Sicilian	U. S. Dept. from Italy	

POLE VARIETIES.

Creaseback, from Landreth, is a quick-growing sort, and reached edible maturity among the first. The runners were of medium length and thickly set with long, dark green, glossy, tender pods.

July Runner, sent out by J. M. Thorburn & Co., is another quick maturing sort. The vines are long and productive; pods are light green, stringless, tender, and contain six to eight white, kidney-shaped beans.

King of the Garden, received from Holmes, were tall, coarse, rank growers. The runners were very long and yielded only a few large pods of coarse quality.

Leviathan, Henderson, is six to eight days earlier than a majority of the limas; pods are short, light green, and contain two to three flat, tender beans. Desirable as a quick growing, early sort.

Long Podded Ten Weeks, Rawson, is a vigorous grower. The pods are long, flat, broad and tough, but the beans are flat, white and tender, and are desirable for shelled beans.

White Dwarf, from D. M. Ferry & Co., is a bushy growing sort with short runners; pods are numerous, long and broad; beans long, broad, flat, and have a delightful flavor. Desirable.

4352, 4353, 4970, 4973, 4974 and 4980 are varieties of beans sent here by the U. S. Department of Agriculture for testing.

4352 has an upright, stocky habit. The stalk is square, averaging about two feet in height; foliage smooth; pods are situated at the base of the leaf stalks, large, coarse, and four to six inches long, upright, smooth and pointed. The beans failed to set except in a very few of the lower pods, which contained one large, flat, brown bean.

4353 strongly resembled the former, except that the pods were shorter and the beans filled out better. The beans have a thick, tough outer skin, that can be removed easily, leaving a very tender, sweet, pea-flavored bean that when cooked made a very palatable soup. They are called Horse beans, and by those familiar with their use are considered an excellent bean.

4970 was a tall, pole variety, with runners six to eight feet in length. The foliage resembled that of lima beans, and the vines were thickly set with bright purple blossoms, but failed to develop any seed pods.

4973 formed very vigorous plants, sending out long, slender runners. The foliage was much like the lima bean, but the pods were numerous, small, round, yellow, tender and sappy, averaging about twenty-four inches in length, and were filled with small, round, chocolate-colored beans.

4974 strongly resembled 4973, except that the pods were greenish red. The foliage is nearly identical with that of Henderson's Bush Lima.

4980 was a vigorous growing variety of cow pea and made a tall, bushy growth. They are often grown and plowed under as a green manure.

CABBAGES, 1900.

The tests of the cabbage family for this season included thirteen varieties of early cabbage, six of medium, nine Savoy, six red, four of kale, three kohl rabi, and several varieties of broccoli sent from the Department of Agriculture at Washington.

The cauliflower and late cabbage were so badly affected by the black rot that it was impossible to make any comparisons.

Among the early cabbage there were no varieties that were improvements over the old standard sorts.

CABBAGES—1900.

Early Varieties.	Seedsmen.	Date.		Number of days to maturity.	Per cent of plants headed.	Average weight of heads in pounds.
		First mature head.	Market maturity.			
All Head	Vaughan	July 17	July 27	87	55	3.8
Charleston	Ferry	“ 2	“ 12	75	98	4.2
Drumhead	Vaughan	“ 18	“ 20	80	85	4.4
Earliest	Vaughan	“ 2	“ 10	70	96	3.1
Earliest Etampes	Vaughan	“ 2	“ 14	74	50	3.2
Express	Vaughan	“ 2	“ 10	70	90	3.1
Early Jersey Wakefield	Vaughan	“ 2	“ 10	70	96	4.
Henderson Early Summer	Vaughan	“ 8	“ 12	76	98	4.2
Lightning	Vaughan	“ 6	“ 16	76	75	3.6
Limited Mail	Holmes	“ 14	“ 26	86	65	3.8
Little Pixie	Weeber & Don	“ 7	“ 20	80	65	2.8
Wheeler Improved	Weeber & Don	“ 6	“ 28	88	48	4.3
White Giant	Vaughan	“ 16	“ 30	90	75	4.8
Medium Early.						
Admiral Dewey	Mills	Aug. 1	Aug. 12	86	75	4.6
All Seasons	Ferry	“ 4	“ 16	90	90	5 5
All Seasons	Vaughan	“ 4	“ 16	90	90	5.6
Autumn King	Vaughan	“ 10	“ 22	95	95	6.
Succession	Vaughan	“ 6	“ 18	92	85	6.
Vandergaw	Vaughan	“ 8	“ 16	94	50	5.9
Red Cabbages.						
Buxton Drumhead	Vaughan	“ 10	“ 20	110	65	5.6
Dark Red Dutch	Vaughan	“ 16	“ 28	118	50	4.5
Drumhead	Vaughan	“ 8	“ 20	110	55	5.1
Extra Early Dark Red Erfurt	Vaughan	July 28	“ 10	100	68	4.2
Giant Dark Red Erfurt	Vaughan	Aug. 14	“ 30	120	72	5.2
Mammoth Rock	Vaughan	“ 16	“ 24	114	65	5.4
Savoy Cabbages.						
American Improved	Burpee	“ 6	“ 20	110	73	4.5
Belleville	Burpee	“ 8	“ 14	104	55	3.8
DeVertus	Vaughan	“ 6	“ 10	100	45	3.9
Extra Early Paris	Vaughan	July 24	“ 2	92	39	2.5
Hard Heading	Johnson & Stokes	Aug. 2	“ 16	106	48	3.5
Marvin	Vaughan	“ 10	“ 20	110	51	3.8
Number 62	Burpee	“ 6	“ 20	110	61	3.2
Number 99	Burpee	“ 14	“ 28	118	65	3.5
Small Ulm	Vaughan	“ 6	“ 16	106	48	2.2

Early Jersey Wakefield, for pointed, and Henderson Early Summer, for flat heads, have no superiors in quality or earliness; some others, however, are about as good, but the strains are often mixed and not true to type.

In the medium class, Autumn King and Succession produced the largest heads, but it took a little more time to mature them than it did Admiral Dewey.

The first two mentioned are standard varieties and if planted late are good for winter keeping.

SAVOY VARIETIES.

The Savoy heads averaged small, but the tenderness and pleasant flavor of the closely curled leaves make them very desirable.

American Improved, from Burpee, developed the largest heads, the quality of which could not be surpassed.

Extra Early Paris, sent out by Vaughan, matures early, but the heads are very small; quality, good.

New Savoy Numbers 62 and 99, received from Burpee, were very similar. The size is medium, and the quality all that could be desired.

RED CABBAGES.

Red cabbages are very desirable for pickling and are grown quite largely in some sections, although the general demand is limited.

A few varieties were obtained from J. C. Vaughan, Chicago, Ill., which proved to be pure in strain and desirable among their class.

There was no great difference in quality, the size and date of maturity being the marked distinctions.

Extra Early Dark Red Erfurt is all that its name signifies, and is a good extra early sort, but for later use the Drumhead or Mammoth Rock is preferable.

KALE.

The Dwarf Scotch, Moss, Green Curled and Siberian are four leading varieties of this vegetable.

The Dwarf Scotch is low growing; leaves finely cut, much crinkled, and when properly cooked they are a very palatable dish.

The Green Curled and Siberian are much coarser and quite strong in flavor.

BROCCOLI.

Several varieties were received from the U. S. Department of Agriculture for testing, but none of them proved to be of any value. They failed to set any heads.

Number 4355 is the same as 4356, except that it has purple colored foliage.

4356 grew over three feet tall and developed into a coarse, scraggly mass of leaves. The seed stalks started late in the season, but no heads formed. It was of no value.

4357 grew about two feet high. It was of a dark green color, similar in appearance to smooth kale. No heads formed.

4358 was tall and vigorous and threw out seed stalks early in the season, forming a coarse, bushy mass similar in appearance to wild mustard. The foliage was dark green and somewhat crinkled, like Savoy cabbage leaves.

4359 was identical with 4355, except being a little taller, but not quite as strong as 4356.

4482 was a dark purple, spreading mass, between three and four feet in height. No heads appeared.

4483 was similar to 4482, except more dwarf in habit. As none of these formed heads it was impossible to judge of their value, although in other sections the conditions or climate might be such that they would prove to be worthy of growing.

SWEET CORN, 1900.

NOTES BY C. W. HAVEN.

TABLE OF VARIETIES OF CORN, 1900.

Varieties.	Seedsmen.	Ears per square rod.	No. of days from planting to maturity.	Height of stalk, feet.	Average.		No. of rows of kernels per ear.	Length of kernels, inches.	Diam. of cob, inches.	Weight of ears, ounces.
					No. of ears per stalk.	Length of ears, inches.				
Concord	Ferry	89	87	4	1	8	14	.5	.81	8.5
Country Gentleman	Ferry	120	94	6	1.3	7.5	16	.56	.75	8
Don	Weeber & Don	90	80	3.5	1.1	7.5	12	.56	.81	10.75
Early Evergreen	Ferry	105	91	4.5	1.4	7	20	.44	.94	9.75
Early Mammoth	Weeber & Don	89	104	7.5	1.5	9.5	12	.56	.88	10.5
Kansas Sunflower	Barteldes	82	91	9	1	8	16	.56	.81	11
Mammoth	Ferry	119	97	7.33	1.3	10	16	.62	.88	13.5
Minnesota	Ferry	101	91	4.5	.9	7.5	8	.5	.75	6.5
New Corn No. 7	Mills	101	97	6	.85	7.5	10	.44	.88	8.5
Peep of Day	Northrup, King & Co.	98	68	4	1	7	8	.31	.81	7
Portland	Northrup, King & Co.	109	93	6	1.4	7.5	12	.44	.75	7.5
Sampson Early	A. J. Brown Co.	112	89	6.5	1.5	9	18	.62	1	14
Stabler Early	Dreer	83	84	6.66	1.1	8	16	.5	.69	9
Stowell	Ferry	121	100	7.5	1.4	8	16	.56	.81	11
Trucker's Favorite	Wood & Sons	118	102	8	1.5	9	20	.44	.75	11
White Cory (Mam.)	Ferry	99.2	72	3 85	.9	7.5	12	.38	1	10

Concord.—This variety was badly affected with smut. Is low growing, producing good-sized ears, fairly well filled at both ends. Kernels are of good size, tender and milky. The quality is medium.

Country Gentleman.—Very nearly free from smut. Is an attractive grower, producing medium-sized, well-filled ears. Kernels are not arranged in rows, are small, round, of good length, tender, milky, and very sweet.

Don.—This is a dwarf early sort and was badly affected with smut. Ears are large, but not well filled. Kernels are large, deep, milky, but tough. As to quality, this variety does not rank very high, not being very sweet.

Early Evergreen.—This variety is of medium height and had but little smut. Ears are large, fairly well filled. Kernels are small, deep, tender, milky and very sweet. This is one of the older sorts and is to be recommended as a medium sort.

Early Mammoth.—Stalks are of large size and nearly free from smut. Ears are very large, but not well filled. Kernels are large, milky, tough, and of medium quality. The name might lead one to think it was an early variety, but it required one hundred four days from planting to maturity, or two days more than any other variety tested.

Kansas Sunflower.—This variety is a very rank grower, stalks being of large size; nearly free from smut. Ears are large, well filled. Kernels are of medium size, tender but not sweet. This variety has the appearance of field corn, both as to size of stalks and as to quality.

Mammoth.—As the name indicates, this is a large variety; has some smut. Ears are very long and fairly well filled. Kernels are of good size, deep, tender, milky, and of good quality.

Minnesota.—This is a dwarf grower and was badly smutted. Ears are of medium size and well filled. Kernels are large, flat, milky, tough and not sweet.

New No. 7.—A large variety and free from smut. Ears are of good size and fairly well filled. Kernels are of good size, flat, milky, fairly tender, and medium in quality.

Peep of Day.—An attractive extra early sort. Had some smut. Not as large stalks or ears as White Cory, but is a quick growing corn. Ears are good sized and fairly well filled at both ends. Kernels are tender, milky, and of medium quality, although this variety is not a strictly sugar corn.

Portland.—This is a tall grower, but the stalks are small; some smut. Ears are good sized and fairly well filled. Kernels are small, flat, not very milky, tough, but of fair quality.

Sampson's Early.—Stalks large, having a little smut. Ears very large, not well filled. Kernels are of fair size, narrow, deep, not milky, tough and of poor quality.

Stabler's Early.—This is an early sort, producing medium-sized stalks; nearly free from smut. Ears are long and fairly well filled. Kernels are of fair size, narrow, deep, tender, milky, and of medium quality.

Stowell.—Is a large grower, badly smutted. Ears are large and well filled. Kernels are of medium size, narrow, deep, milky, tender, and medium in quality. This variety is one of the older standard late sorts.

Trucker's Favorite.—A very large variety, quite badly affected with smut. Ears are large and fairly well filled. Kernels are small, milky, tender, but of poor quality.

White Cory (Mam.).—A good strain, free from smut. Ears are good sized and well filled for an extra early sort. Kernels are of good size, deep, milky and tender. This variety is one of the best standard extra early kinds.

Summary.—For a succession of corn through the season the most desirable early kinds are as follows: White Cory and Peep of Day. The latter variety was the first to mature, but the quality is not equal to White Cory.

For medium sorts, Country Gentleman and Early Evergreen are varieties that have no superior. Sampson Early has proved a desirable medium sort in the past. Mammoth and Stowell can be recommended as late sorts.

CUCUMBERS, 1900.

Twenty-four varieties of cucumbers were planted June 8 in squares six feet each way.

The soil was prepared early in the season and worked often until the time of planting, when the seed was dropped in moist soil, covered shallow, and after the plants were about two inches high they were thinned, leaving only four of the strongest plants.

Varieties.	Seedsmen.	Date of pickling size.	Date of slicing size.	Productiveness.
Beauty	Childs	Aug. 1	Aug. 6	85
Chicago	Ferry	" 4	" 10	80
Cool and crisp	Ferry	" 2	" 7	90
Emerald	Livingston	" 6	" 12	80
Everbearing	Henderson	" 5	" 10	90
Fordhook Pickling	Burpee	" 5	" 11	90
Goliath	Olds	" 10	" 14	75
Henderson	Henderson	" 4	" 10	80
Hills Forcing	Vaughan	July 28	" 2	80
Japanese Climbing	Vaughan	Aug. 10	" 15	75
Jersey Pickling	Vaughan	" 4	" 9	85
Long Green Improved	Vaughan	" 6	" 10	80
Model	Wood	" 5	" 10	75
Nonesuch	Salzer	" 4	" 8	80
Rockford Pickle	Buckbee	" 2	" 6	75
Siberian	Vaughan	" 6	" 10	70
West India Gherkin	Ferry	" 6	....	98
White Giant	Vaughan	" 8	Aug. 12	90
White Spine, Arlington	Vaughan	" 4	" 9	95
White Spine, Early	Vaughan	July 26	" 1	90
White Spine, Extra Long	Vaughan	Aug. 4	" 8	80
239	Buckbee	" 3	" 7	85
4990	U. S. Department	" 3	" 7	80
4991	U. S. Department	" 4	" 8	75

The following are brief notes on some sorts not previously grown:

Chicago is a variety of the White Spine type that is largely grown near the city after which it is named. It is smooth, uniform in shape and size, and of good color for pickling.

The quality is desirable for slicing, but they often get bitter if the weather is dry.

Cool and Crisp is of the Arlington White Spine type, but is liable to grow pointed at the ends and bulged in the center, which gives them an undesirable appearance. This trouble has manifested itself more in the forcing house than in field culture.

Everbearing did not prove to be of much value. They grew short, pointed and seedy. In some localities they are considered very valuable.

Henderson appears to be a selected strain of the White Spine. The cucumbers are long, slender, uniform, good growers and of long season.

Jersey Pickling and Long Green Improved are two similar varieties received from J. C. Vaughan, of Chicago. They are both good sorts and desirable for pickling and slicing.

Rockford Pickle is a variety especially desirable for small pickles. They are very prolific, but seed quickly, and the vines seem to be very susceptible to drouth.

4990 and 4991 are two sorts received from the U. S. Department of Agriculture. The only perceptible difference is that the former is darker colored and slimmer than the latter.

4991 is long, smooth, light colored, uniform in size and shape; spines scattering. They are both of the White Spine type and desirable for pickling or slicing.

It is very prolific of smooth, uniform pickles, well filled at both ends, but they soon become too seedy for slicing and are not as good flavored as some other sorts.

West India Gherkin is of no value, except when picked very small, then they make desirable pickles. They soon become tough, seedy and very bitter.

White Giant is a large strain of the White Spine class, rather coarse, but smooth and of good quality.

The White Spine varieties, including Arlington, Early and Extra Long, are standard sorts that need no description, all being very desirable. They differ only in minor points, such as earliness, shape or size.

Number 239, sent out by Buckbee, is a long, thick-growing variety, with scattering spines.

LETTUCE, 1900.

In 1899 about 300 varieties of lettuce were grown as a duplicate experiment for the Department of Agriculture at Washington.

Many of them proved to be the same variety under different names.

For the test made in 1900 seed was saved from some of the better sorts and is listed in the tables as from the Department, but the other varieties tested were received from the seedsmen named.

Some of the varieties were grown under glass with good results, but Grand Rapids is the leading forcing variety in Michigan.

There seems to be a very small demand for the heading sorts, but Big Boston and Hot House are among the more desirable varieties.

For the outdoor trial the seed was sown in the field May 7 in a warm sand loam, and the results are given in the following table and notes:

All Right, from Johnson & Stokes, is a large growing heading variety. The outer leaves have a glossy appearance, with a delicate pink, smooth margin; head well blanched, tender and crisp, but a little bitter. Its length of edible maturity makes it of value. Strongly resembles Big Boston.

All Seasons, Vaughan, is of the large heading type. It matures rather slowly, but stands a long time before the seed stalks start. The leaves are smooth, dull dark green; heads large, compact, crisp and tender, but in damp, hot weather it is very susceptible to rot.

Asparagus, received from Peter Henderson & Co., is a tall, narrow-leaved sort of no especial value.

Bath Cos is a dark green, purplish sort. The leaves, which are broad and flat, and have finely serrated margins, form quite a close head.

Big Boston was grown by the side of All Right and they seemed to be identical. They are two good varieties for garden use.

Varieties.	Seedsmen.	Habit of growth.	Color.
All Right	Johnson & Stokes	Heading	Green with pink margin.
All Seasons	J. C. Vaughan	Heading	Dark green.
Asparagus	Peter Henderson	Open	Dark green.
Bath Cos	Department	Loose, open	Purple green.
Big Boston	Department	Solid, heading	Green with pink margin.
Blonde Beauty	Department	Compact heading	Light green.
Bronze Curled	D. Landreth Co	Open, loose	Bronze red.
Bronze Red	Department	Compact head	Dark bronze red.
Brown Dutch	Department	Half heading	Dull green red.
Buckbee Forcing	H. W. Buckbee	Open, loose	Light green.
California Cream Butter	W. A. Burpee	Close heading	Light green.
Crisp as Ice	Department	Compact heading	Bronze red.
Detroit Market	Department	Open, loose	Bright green.
Denver Market	Department	Open, loose	Bright green.
Early Curled Silesia	Department	Loose	Bright green.
Grand Rapids Forcing	Vick Sons	Open, spreading	Bright green.
Gray Seeded Butter	Department	Compact heading	Bright green.
Green Fringed	Department	Low, spreading	Light green.
Hamilton Market	J. A. Bruce	Open, loose	Bright green.
Henderson New York	Peter Henderson	Open, loose	Bright green.
Hero	Vick Sons	Loose heading	Green with purple margin.
Iceberg	Department.	Open heading	Dark green.
Ice Drumhead	H. W. Buckbee	Large, open head	Dark green, purple border.
Lancaster	W. A. Burpee	Loose, open head	Dark green.
Lewis	Department	Open, loose	Light green.
Maximus	J. M. Thorburn	Close heading	Dark green.
Morse	Department	Open, wrinkled	Bright green.
Mignonette	Peter Henderson	Open, wrinkled	Purple tinted.
Nonpariel	J. A. Bruce	Open, loose heading.	Lt. green, fringed margin.
Onondaga	Department	Open, loose, crinkled	Light green.
Rawson's Curl Leaf Hot House	W. W. Rawson	Small, solid head	Light green.
Salamander	Johnson & Stokes	Open, loose head	Green.
Sugar Loaf	J. J. H. Gregory	Large, close heading	Green, purple tinted.
Tennis Ball	J. M. Thorburn	Compact solid head	Bright green.
Tomhannock	W. A. Burpee	Large, open, crinkled	Green, red tinted.
Tyrol	Department	Close, compact, “	Bright green.
Virginia Solid Head	Department	Compact heading	Green, purple tinted b'd'r.
Waldorf	Peter Henderson	Small, solid heading.	Light green.
Woods Cabbage	Department	Large, solid heading.	Light green.
White Cos	Department	Upright, loose	Dark green.

Blonde Beauty is somewhat wrinkled and appears to be a type about half way between Grand Rapids and All Seasons. The leaves are coarse and form large, compact heads. The edible maturity is of long duration.

Bronze Curled, from Landreth, is a very attractive bronze red variety. The leaves are small, closely crinkled, very crisp and mild flavored. It stands well and is one of the best red sorts.

Bronze Red is darker red than the former and forms a more compact head. The delicately colored margins of the leaves forming the large, solid heads, together with the desirable quality, makes it one of the leading sorts of its class.

Brown Dutch has a dull, greenish-red color; leaves are smooth and form a loose, open head. Not as desirable as either of the other bronze varieties.

Buckbee Forcing is of the Grand Rapids type, but the leaves are not as much crinkled. It grows upright, matures quickly, seeds readily. The quality is good and appears to be valuable for a quick growing sort.

California Cream Butter is a small heading sort of good quality. The leaves are small, oval, smooth, closely covering the compact tender head.

Crisp as Ice is one of the best red varieties. It is very attractive and of excellent quality. The heads are not large, but are compact and tender.

Detroit Market is of the same type as Buckbee's Forcing, but does not grow quite as large.

Denver Market is very attractive for its kind. The leaves are finely crinkled, large, crisp and tender. Matures quickly and stands for a good period.

Early Curled Silesia appears to be very much like Grand Rapids Forcing. It is a quick grower, leaves are tender, but are not strong enough in the mid-rib to stand erect. Of no value, except as a quick grower.

Grand Rapids Forcing is a variety of a very strong type. It was originated by Mr. Eugene Davis, of Grand Rapids, Michigan, and in the west for fifteen years has been grown as a forcing variety more extensively than any other sort. It is resistant to fungous diseases, of good quality, and will develop open heads weighing from 12 to 16 ounces each.

Gray Seeded Butter is a compact heading green sort; leaves are large and smooth, and closely envelop the tender, blanched head. The quality is all that is desired.

Green Fringed is a very attractive light green variety. The leaves are broad, low growing, and form large, flat stools; margins are crinkled and finely serrated or fringed. Matures slowly and stands well.

Hamilton Market is identical with Denver Market.

Henderson's New York seemed to be the same as Detroit Market.

Hero has large, broad, smooth leaves with purple margins. It is of the heading type, but the heads are loose and open, tough and strong. It is a long standing variety.

Iceberg is very similar to All Seasons, a large, open heading sort of good quality.

Ice Drumhead is a purple bordered, wrinkled sort, which forms a large open head of fine texture; leaves are very tender and mild. Its edible duration is of good length.

Lancaster is a small, smooth-leaved, spreading, bright green sort. The leaves are tender, but too small to be of any special value.

Lewis appears to be simply a selected strain of Grand Rapids.

Maximus is a green, coarse, broad-leaved, close heading sort. The heads are large, well blanched, crisp and tender. One of the best large heading sorts.

Morse is one of the largest crinkled sorts of the Grand Rapids type, but the leaves are coarse and tough and of inferior quality. It is a long standing variety.

Mignonette. a purple-tinted, wrinkled sort, of good quality, but it seeds very early.

Nonpariel is very much like Green Fringed. The leaves are the same shape but head up a little better; quality good.

Onondaga is of the same type and habit of growth as Grand Rapids, but has a bright scarlet color. It is very attractive, long standing and of the best quality.

Rawson's Curl Leaf Hot House, a small growing head sort; is too small and seeds too soon to be of any special value outside.

Salamander, a long, narrow-leaved sort; forms quite a head and the quality is good for this class, but there are many better varieties.

Sugar Loaf is a very large, broad-leaved heading sort; the heads are loose and with age color quite dark. The quality is good. Desirable.

Tennis Ball.—One of the standard green sorts. It is slow maturing, long standing, and of desirable quality.

Tomhannock is one of the most desirable sorts of its class. The leaves are large, closely crinkled and have a red tinted margin, and quality hard to excel.

Tyrol.—A close, compact, crinkled sort of good quality and long edible condition.

Virginia Solid Head is a small-headed sort with purple tinted margins. It matures quickly and is of good quality, but the seed stalks start very early.

Waldorf is a small-leaved, light colored heading sort. It matures quickly, but has the same fault as Virginia Solid Head relative to the seed stalks. The quality is good.

Woods' Cabbage was true to its name as a cabbage type and showed to be a very pure strain. The heads were large, firm, nicely blanched, very tender and palatable. It is one of the best green heading sorts.

White Cos is one of the best Cos sorts. The leaves are long, slender and very crisp.

PEAS, 1900.

NOTES BY C. W. HAVEN.

A-1, a new early pea from Gregory. Vines two and one-half to three feet high, very vigorous and fairly productive. Foliage light green. Pods medium long and broad (2¾x¾ in.), pointed at apex, thick, rough, and do not fill well. Peas are of good size and flavor and average six to the pod.

Advancer, from Ferry. Vines two to two and one-half feet high, very vigorous and productive. Foliage dark green. Pods very numerous, canoe shaped, blunt at apex, medium size (3x¾ in.), well filled, thin skin. Peas very sweet. Vines seriously affected with rust.

Alaska, from Ferry. Vines two to two and one-half feet high, vigorous, fairly productive. Foliage light green. Pods few, long and narrow (2¾x⅝ in.), well filled. Peas fairly sweet. This variety was the first to mature.

American Champion, from Henderson. Vines very rank growing, three to three and one-half feet high; foliage light green. Pods few, long and broad (3¾x⅞ in.), apex pointed, well filled, thick skin. Peas very sweet. This variety is of the Telephone type.

American Wonder, from Ferry. Vines dwarf growing, nine to fifteen inches high, vigorous; foliage dark green. Pods very numerous, light green, long and narrow (2¾x⅝ in.), thin, well filled, apex somewhat pointed. Peas large and fairly sweet. This variety was badly affected with rust and anthracnose.

Burpee's Best, from Burpee. Vines vigorous, three feet high; foliage light green. Pods short and narrow (2½x½ in.), quite numerous, well filled, stem end pointed, apex somewhat blunt, thin skin. Peas not very sweet. This variety was affected with rust and anthracnose.

Champion of England, from Ferry. Vines very rank growing, three feet high; foliage light green. Pods long, narrow and thick (3x⅝ in.), very numerous, well filled, apex blunt. Peas very sweet.

Dwarf Telephone, from Gregory. Vines very vigorous, eighteen inches high; foliage light green. Pods few, very large (4¼x¾ in.), not well filled, apex pointed. Peas very sweet.

Early Marrowfat, from Gregory. Vines rank growing, forty-two inches high; foliage light green. Pods short, broad and flat (2⅝x⅝ in.), few, poorly filled, apex blunt. Peas not very sweet.

Electric, from Dreer. Vines two feet high, very vigorous; foliage dark green. Pods short and narrow (2½x⅝ in.), numerous, well filled, pointed at both ends, skin thick. Peas very sweet.

Empire State, from Gregory. Vines fifteen inches high, very vigorous; foliage, dark green. Pods long and narrow (3⅜x¾ in.), stem end pointed, apex blunt, thick skin. Peas sweet.

TABLE OF VARIETIES OF PEAS, 1900.

Varieties.	Seedsmen.	Per cent grew.	Date.		No. of days from planting to edible maturity.	Length of edible maturity, days.	No. peas per pod.	Per cent peas to total weight.	Height of vines, inches.
			First blossom.	Edible maturity.					
A-1	Gregory	75	June 4	June 15	50	6-8	6	29.5	30
Advancer	Ferry	80	" 10	" 23	58	5-9	7	41	24
Alaska	Ferry	78	" 5	" 14	49	6-8	6	41.6	30
American Champion	Henderson	90	" 12	July 1	65	10	6	40	40
American Wonder	Ferry	80	" 10	June 18	53	10	6	43	15
Burpee's Best	Burpee	90	" 10	" 18	53	8-10	7	42.8	36
Champion of England	Ferry	95	" 15	July 1	65	10-12	5	42.8	36
Dwarf Telephone	Gregory	80	" 14	" 4	68	8-10	7	34.7	18
Early Marrowfat	Gregory	85	" 16	" 5	69	8	6	33.3	42
Electric	Dreer	95	" 4	June 15	50	8-10	6	40	24
Empire State	Gregory	88	" 12	" 24	59	10-12	8	41.3	15
Excelsior	Gregory	85	" 8	" 18	53	9	6	35.7	15
Gradus	Ferry	78	" 8	" 20	55	10-12	7	33.3	36
Heroine	Henderson	75	" 13	July 6	70	8	8	44.4	24
May Queen	Gregory	80	" 8	June 16	51	6-8	5	26.9	30
New York Market	Weeber & Don	75	" 4	" 15	50	10-12	7	40	36
Stratagem	Ferry	75	" 13	July 3	67	10-12	8	40	18

Excelsior, from Gregory. Vines fifteen inches high, vigorous; foliage light green. Pods long and broad (3½x⅞ in.), not numerous, fairly well filled, both ends rather pointed, thick skin. Peas fairly sweet. This is an early variety, maturing four days later than Alaska, and is of about the same quality.

Gradus, from Ferry. Vines three feet high, vigorous; foliage, light green. Pods very large, long and broad (4¼x⅞ in.), numerous, well filled, pointed at both ends, very thick skin. Peas very sweet. Foliage was badly affected with rust and anthracnose.

Heroine, from Henderson. Vines two feet high, very vigorous; foliage dark green. Pods very large, broad and flat (3¾x⅞ in.), not numerous, pointed at both ends, thick skin. Peas fairly sweet. This variety averaged eight peas to the pod, thus exceeding all others, excepting Stratagem.

May Queen, from Gregory. Vines thirty inches high, vigorous growing; foliage light green. Pods medium to large (3x⅝ in.), not very numerous, not well filled, stem end pointed, apex rather blunt, very thick skin. Peas very sweet. This variety is much like A-1 as to quality.

New York Market, from Weeber & Don. Vines thirty-six inches high, vigorous; foliage dark green. Pods short and broad (3x⅝ in.), very numerous, well filled, stem end pointed, apex blunt, thick skin. Peas of fine quality.

Stratagem, from Ferry. Vines eighteen inches high, very vigorous; foliage dark green. Pods very large, long and broad (4x⅝ in.), numerous, well filled, pointed at both ends; skin very thick. Peas sweet. This is extra good as a large podded variety.

Summary.—To secure a succession of peas the following varieties can be recommended.

For early sorts: Gradus, Alaska, Electric, May Queen and New York Market.

Second early sorts: Advancer and American Wonder.

Medium sorts: Empire State.

Late sorts: American Champion, Dwarf Telephone, Champion of England and Heroine.

POTATOES, 1900.

The potato experimental plot for 1900 was located in the northeast corner of the vegetable garden. Small fruits had been grown on the land for several years and, after the crop had been gathered in 1899, the ground was plowed, worked down and sowed to turnips about August 1. The soil is a sand loam mixed with clay and is rich in vegetable matter. After the root crop was harvested the ground was top dressed with finely composted manure. In the spring, as soon as the soil was in suitable condition, it was plowed, rolled and harrowed at frequent intervals, until the time of planting. The early sorts were planted May 5 and the late ones June 5.

The seed was treated with corrosive sublimate (1-2000) for forty-five minutes and only a small amount of scab developed. The season was very favorable for the growth of plants and irrigation was not necessary; in fact, owing to the clay composition of the soil, a portion of it was too wet at times.

At the time of planting the ground was marked and furrowed about five inches deep and three and one-half apart, each variety being given forty feet space in the row. Two pounds of seed was used for each variety, cut into twenty-five pieces, which were dropped about eighteen inches apart and covered with a hoe. The ground was then rolled and immediately worked with a Breed's weeder, which tool was used at intervals of three to four days until the plants were injured by it; then the Planet Jr. cultivator was used as long as the crop needed cultivating. Shallow, level cultivation was at all times strictly adhered to.

But slight injury was done by the Colorado beetle, as twice during the season, to prevent against insect and fungous attacks, the crop was sprayed with Bordeaux mixture, with which an arsenite was mixed. Owing to its cheapness, white arsenic has been used for several years with good results. It must be prepared by boiling it for forty minutes with twice its weight of lime that has been freshly slaked, two gallons of water being used for each pound of arsenic. One pound of arsenic will answer for 150 to 200 gallons of Bordeaux mixture.

At the time of harvesting, seed is selected for the following year by choosing typical specimens from the hills that gave the best results. In this way the running out of the variety is largely prevented, and if the method was practiced by the general grower a better grade of potatoes could be secured.

To maintain its vigor, the seed should be kept from sprouting, which can be easily done by placing it in a cool, dark cellar, or burying it on the north side of a building until planting time.

TABLE OF VARIETIES OF POTATOES, 1900.

[Planted May 5.]

Varieties.	Seedsmen.	Height and color of vines.	Date of maturity.		Yield per acre, bushels.			Average yield for 1899 and 1900.	General average.	Number of years averaged.
		Inches L. G. (light green) D. G. (dark green) Med. (Medium).	Edible.	Market.	Large.	Small.	Total.			
Acme	Department..	26—Med.	July 8	July 28	132 17	23.32	155.49	147.71	134.23	5
Alexander Ex. Ey	Presley	23—D. G.	“ 4	“ 20	132.17	25.91	158.08	......	......	1
Andes	Department..	23—Med.	“ 6	“ 24	147.72	20.73	168.45	193.07	146.42	4
Belle	Department..	23—D. G.	“ 4	“ 14	59.6	18.14	77.74	80.33	121.28	5
Blush	Department..	21—D. G.	“ 18	Aug. 1	150.31	15.55	165.86	147.72	150.3	4
Bovee	Department..	24—Med.	“ 14	July 26	129.58	54.42	184	203.44	179.26	6
Bovee	Barteldes	15—D. G.	“ 16	“ 30	129.58	15.54	145.12	......	......	1
Coles Early	Presley	22—D. G.	“ 10	“ 24	134.76	20.73	155.49	......	......	1
Dawn	Department..	24—Med.	“ 18	“ 24	158.09	25.91	184	168.45	139.92	3
Dew Drop	Presley	19—Med.	“ 12	“ 20	98.48	31.1	129.58	......	......	1
Delaware	Department..	25—L. G.	“ 21	Aug. 6	225.47	15.55	241.02	185.3	229.78	3
Garfield	Department..	23—L. G.	“ 22	“ 6	160.68	18.14	178.82	172.34	222.01	3
Herrington Peer	Department..	22—Med.	“ 16	July 26	145.13	41.46	186.6	158.09	226.76	4
Honeoye Rose	Department..	29—D. G.	“ 16	Aug. 1	207.33	33.69	241.02	191.78	152.9	5
Hurst	Department..	21—Med.	“ 16	July 26	189.19	23.32	212.51	193.07	194.37	3
Irish Cobbler	Department..	23—Med.	“ 16	“ 20	64.79	27.01	121.81	112.73	167.73	5
Kansas	Department..	28—Dark.	“ 26	Aug. 4	142.54	28.5	171.05	155.5	158.61	4
May	Department..	20—Med.	“ 16	July 30	150.31	51.83	202.14	221.58	......	2
Michigan	Department..	21—L. G.	“ 6	“ 20	121.81	67.38	189.19	225.47	179.19	5
Minnehaha	Department..	24—D. G.	“ 16	“ 28	186.6	69.96	256.56	228.05	198.68	3
Montana Rose	Department..	25—Med.	“ 18	“ 30	165.86	54.42	219.29	241.82	214.77	3
Norther	Department..	27—Med.	“ 15	“ 20	121.81	77.75	199 56	231.95	206.35	5
Northern Beauty	Presley	27—D. G.	“ 13	“ 22	196.96	36.28	233.24	......	......	1
Ohio	Presley	26—D. G.	“ 6	“ 24	165.86	18.14	184	152.9	153.73	3
Peachblow	Presley	24—D. G.	“ 20	“ 26	155 51	15.55	171.06	173.64	186.06	6
Pingree	Presley	24—Med.	“ 12	“ 20	116.62	77.75	194.37	191.87	......	2
Pinkeye	Presley	25—L. G.	“ 14	“ 28	181.41	36.28	217.7	186.6	155.54	5
Quick Crop	Presley	21—L. G.	“ 15	“ 24	160.68	64.7	225.47	215 1	163.26	5
Reads 86	Presley	19—Med.	“ 15	“ 30	103.66	93.3	196.96	191.78	146.31	6
Richmond Belle	Presley	17—D. G.	“ 16	“ 30	111.44	7.77	119.21	126.98	165.86	3
Roberts	Presley	23—L. G.	“ 10	“ 20	202.15	41.46	243.61	202.14	176.96	3
Salzer's Earliest	Salzer	26—L. G.	“ 16	“ 24	165.86	20.73	186.6	......	......	1
Silver Crown	Presley	22—D. G.	“ 10	“ 20	139.95	15.55	155.5	......	......	1
Six Weeks	Department..	24—Med.	“ 16	“ 26	155.51	25.91	181.41	167.16	127.95	4
Snowflake Jr	Department..	18—D. G.	“ 18	“ 30	155 51	18.14	173.64	136.06	199.48	7
State of Maine	Department..	24—Med.	“ 14	“ 26	119.21	33.69	152.91	134.76	139.08	3
Sunlight	Salzer	19—L. G.	“ 4	“ 20	248.8	12.95	261.75	......	......	1
Thoroughbred	Department..	20—Med.	“ 12	“ 20	69.96	75.15	145.11	130.86	111.97	5
Trumbull	Department..	20—L. G.	“ 15	“ 25	95.89	80.34	176.23	160.68	139.94	4
White Lily	Department..	19—L. G.	“ 10	“ 20	77.75	46.65	124.4	119.21	127.89	6
White Ohio	Department..	23—L. G.	“ 4	“ 26	69.96	59.6	129.58	142.54	125.69	4
White Rose	Knox	21—L. G.	“ 6	“ 20	171.05	25.91	196.96	......	......	1
Woodhull	Knox	22—Med.	“ 20	“ 28	111.44	67.38	176.22	173.35	180.08	4
Woods Earliest	Knox	20—Med.	“ 4	“ 20	150.31	10.36	160.67	147.71	127.72	3

TABLE OF VARIETIES OF POTATOES—1900.—*Continued.*

[Planted June 5.]

Varieties.	Seedsmen.	Height and color of vines, inches.	Date of maturity.		Yield per acre, bushels.			Average yield for 1899 and 1900.	General average.	Number of years averaged.
		L. G., (light green); D. G., (dark green); Med. (medium).	Edible.	Market.	Large.	Small.	Total.			
Abundance	Department	L. G.—30	Sept. 1	Sept. 18	119.21	36.28	155.50	107.55	174.67	5
Accidental	Department	D. G.—26	" 2	" 12	155.5	25.91	181.41	160.68	126.18	4
Adirondac	Department	L. G.—28	Aug. 28	" 14	248.8	15.55	264.35	191.78	189.7	5
Arizona	Department	L. G.—28	" 28	" 11	212.51	31.1	243.61	202.14	169.09	4
Astonisher	Mills	L. G —27	Sept. 2	" 28	202.15	20.73	222.88	......	......	1
Beauty of Beauties	Department	D. G.—29	" 6	" 15	150.31	10.36	160.68	197.96	162.62	4
Blush	Department	D. G.—24	" 1	" 13	145.13	10.36	155.5	115.32	118.56	4
Burpee's Superior	Department	D. G.—25	" 4	" 15	150.31	10.36	160.67	137.35	137.35	2
California Russet	Department	D. G.—23	" 6	" 18	233.25	15.55	248.8	230.65	......	2
Cannon Ball	Salzer	Med.—29	" 28	Oct. 12	279.89	7.77	287.66	......	......	1
Carman No. 1	Department	D. G.—30	" 1	Sept. 14	181.41	10.36	191.78	191.78	212.54	7
Carman No. 3	Department	D. G.—28	" 5	" 17	228.06	20.73	268.79	292.85	285.76	6
Champion of the World	Department	L. G.—29	" 2	" 11	119.21	15.55	134.76	114.03	154.32	5
Clarendon Beauty	Department	L. G.—26	Aug. 28	" 11	114.03	15.55	129.58	145.13	152.22	4
Clinton	Department	D. G.—24	Sept. 1	" 13	139.95	15.55	155.51	184.01	209.06	3
Columbus	Department	D. G.—30	" 5	" 15	129.58	15.55	145.13	163.27	189.83	4
Columbian	Presley	D. G.—32	" 6	" 18	191.78	15.55	207.33	......	......	1
Commercial	Department	Med.—30	" 6	" 16	248.8	25.91	274.71	251.38	......	2
Dewey	Department	D. G.—28	" 12	" 17	238.43	15.55	259.98	261.75	......	2
Endurance	Department	D. G.—25	" 4	" 16	134.76	15.55	150.31	147.72	126.42	4
English Schoolmaster	Presley	D. G.—24	Aug. 29	" 10	202.15	41.46	243.61	......	......	1
Enormous	Department	L. G.—28	Sept. 10	" 19	150.31	25.91	176.22	193.07	251.38	5
Flagle	Department	D. G.—24	" 11	" 19	160.68	5.18	165.86	155.49	183.54	5
Fottler's Peachblow	Department	D. G.—23	" 4	" 20	207.33	46.65	253.98	187.89	206.03	5
Free Silver	Department	* —24	" 13	" 23	233.25	5.18	238.43	241.02	......	2
Free Trade	Presley	D. G.—23	" 10	" 20	233.25	15.55	248.8	......	......	1
Gem of Aroostook	Gregory	D. G.—28	" 6	" 16	233.25	25.91	259.16	......	......	1
Gem of Aroostook	Presley	D. G.—28	" 6	" 17	243.61	20.73	264.34	......	......	1
German Rose	Olds	Med.—25	" 8	" 17	202.15	31.1	233.25	......	......	1
Good Times	Department	† —22	" 10	" 21	220.88	20.73	243.61	195.66	214.45	4
Hewes	Department	L. G.—24	" 2	" 12	253.98	20.73	274.71	215.11	181.41	3
Hoosier	Department	D. G.—26	" 4	" 13	196.96	10.36	207.32	169.74	111.56	3
Ideal	N. K. & Co.	M. G.—27	" 6	" 15	145.13	15.55	160.68	......	......	1
Irish Mignon	Department	P. G.—24	" 10	" 20	238.43	15.55	253.98	251.1	162.62	4
Junior Pride	N. K. & Co.	D. G.—26	Aug. 1	Aug. 16	171.05	20.73	191.78	......	......	1
Joseph	Department	L. G.—27	Sept. 5	Sept. 15	145.13	25.91	171.04	151.6	184.65	4
Kaiser Krone	Presley	D. G.—28	" 1	" 11	155.51	72.56	228.07	......	......	1
Kaiser Krone	Vaughan	D. G.—28	" 1	" 12	155.51	62.2	217.71	......	......	1
King of Michigan	F. & P.	M. G.—29	" 8	" 18	238.43	25.91	264.34	......	......	1
Keystone	Presley	D. G.—26	" 6	" 15	186.6	25.91	212.51	......	......	1
Klondike	Department	L. G.—30	" 8	" 16	145.13	31.1	176.23	187.89	202.93	4
Leonard	Department	D. G.—30	" 2	" 12	165.86	15.55	181.41	145.13	184.65	4
Lightning Express	Department	D. G.—28	" 10	" 20	145.13	25.91	171.05	149.33	175.07	7
Lincoln	Department	D. G.—26	" 8	" 17	196.96	15.55	212.51	150.31	178.81	4
Livingston	Department	D. G.—24	" 10	" 18	207.33	25.91	233.24	207.32	264.34	3
Livingston Banner	Department	P. G.—26	" 5	" 14	217.7	15.55	233.25	212.51	263.82	5
Long Keeper	Department	D. G.—24	" 28	Oct. 2	220.88	20.73	243.61	152.90	158.43	4
Maggie Murphy	Department	L. G.—24	" 16	Sept. 28	253.98	31.1	285.08	218.91	227.61	5
Maules XXX	Department	Med.—24	" 1	" 11	253.98	10.36	254.34	216.39	189.18	3
McKinley	Olds	P. G.—26	" 14	" 24	248.8	10.36	259.16	228.06	......	2

* Purple D. G.

† D. G. purple.

TABLE OF VARIETIES OF POTATOES—1900.—*Concluded.*

[Planted June 5.]

Varieties.	Seedsmen.	Height and color of vines, inches.	Date of maturity.		Yield per acre, bushels.			Average yield for 1899 and 1900.	General average.	Number of years averaged.
		L. G., (light green); D. G. (dark green); Med., (medium).	Edible.	Market.	Large.	Small.	Total.			
Michigan Beauty	Department	Med.—26	Sept. 3	Sept. 12	212.51	31.1	243.61	181.41	149.79	5
Million Dollar	Salzer	D. G.—20	" 20	" 30	290.26	10.36	300.62	......	......	1
Mills' Banner	Department	P. G.—24	" 16	" 24	171.05	20.73	191.78	141.24	174.83	4
Mills' Prize	Department	L. G.—28	" 16	" 22	103.66	10.36	114.03	123.16	171.73	4
Montana Wonder	Department	Med.—22	" 10	" 14	103.66	20.73	124.4	138.65	147.72	3
Napoleon	Department	D. G.—24	" 4	" 12	98.48	36.28	134.76	145.13	196.96	5
New No. 5	Department	L. G.—27	" 6	" 16	220.88	20.73	243.61	222.88	......	2
Onward	Department	D. G.—28	" 6	" 17	155.51	15.55	171.05	141.24	144.47	4
Padelford	Department	Med.—25	Aug. 24	" 1	171.05	31.1	202.15	165.86	183.14	4
Pat's Choice	Olds	D. G.—29	Sept. 18	" 22	165.86	20.73	186.6	... ..	......	1
Pat's Choice	Presley	D. G.—30	" 10	" 29	176.23	51.83	228.06	......	......	1
Peachblow	Department	D. G.—32	" 19	" 29	186.6	31.1	217.7	149.02	223.91	5
Perfection	Department	D. G.—26	" 1	" 11	217.7	57.01	274.71	231.95	400.39	4
Planet Jr.	Department	L. G.—27	" 10	" 18	155.51	25.91	181.41	154.20	134.38	4
Pride of Michigan	Department	L. G.—20	" 2	" 12	253.98	46.65	300.65	196.96	166.73	3
Pride of Seneca	Department	L. G.—24	" 4	" 12	248.8	41.46	290.26	203.44	177.86	4
Prince Bismarck	Department	D. G.—26	" 1	" 11	248.8	25.91	274.71	215.14	......	2
Rose of Erin	Department	D. G.—28	" 8	" 17	186.6	41.46	228.06	209.92	183.35	4
Rosy Morn	Presley	Med.—26	" 1	" 11	228.06	46.65	274.71	......	......	1
Rose Standish	Department	D. G.—24	" 2	" 11	171.05	36.28	207.33	137.35	169.33	5
Rural New Yorker No. 2	Department	D. G.—29	" 14	" 20	160.68	20.73	181.41	174.93	189.15	11
Seedling No. 2	Department	L. G.—28	" 8	" 18	176.23	25.91	202.14	156.56	130.22	4
Sir Walter	Department	P. G.—29	" 12	" 19	191.78	20.73	212.51	200.85	......	2
Sir Walter Raleigh	Department	D.P.G.-29	" 10	" 16	264.35	20.73	285.08	278.60	200.46	4
St. Lawrence	Presley	Med.—28	" 8	" 20	207.33	20.73	228.06	......	......	1
Suffolk Beauty	Department	D. G.—26	" 6	" 19	196.96	25.91	222.87	154.19	154.19	4
Sweet Home	Vaughan	D. G.—24	" 1	" 12	233.25	15.55	248.8	......	......	1
Taylor	Department	L. G.—30	" 2	" 12	165.86	36.28	212.14	171.04	186.62	3
Twentieth Century	Department	L. G.—24	" 10	" 16	253.98	25.91	279.89	......	......	1
Twentieth Century	Presley	L. G.—23	" 10	" 16	238.43	36.28	274.71	......	......	1
Venezuela	Department	P. G.—22	" 6	" 15	119.21	20.73	139.94	......	......	1
Washington	Presley	L. G.—28	" 2	" 12	238.43	10.36	248.79	......	......	1
Washington	Department	L. G.—26	" 2	" 12	233.25	10.36	243.61	218.10	......	2
White Mammoth	Department	D. G.—29	" 10	" 20	207.33	10.36	217.69	229.28	......	2
Z-1	Crosby	Med.—24	" 8	" 16	191.78	36.28	228.06	......	......	1
Z-2	Crosby	L. G.—22	" 6	" 16	202.15	25.91	228.06	......	......	1

The fungous diseases are certainly on the increase and unless more attention is given to treating the seed and spraying the vines the quality, as well as quantity, of the potato crop is bound to deteriorate.

Each variety is grown for several years to thoroughly test it, after which the inferior kinds are dropped to make room for the newer sorts. A few of the standard kinds are grown longer for the purpose of comparison.

In addition to the seed grown by the College in 1899, the following varieties were received from the seedsmen named:

L. L. Olds, Clinton, Wis.—Pat's Choice, McKinley and German Rose.
F. Barteldes & Co.., Lawrence, Kan.—Bovee.
F. B. Mills, Rose Hill, N. Y.—Astonisher.
T. W. Wood & Sons, Richmond, Va.—Junior Pride.
W. R. Knox, Intercourse, Pa.—White Rose.
J. C. Vaughan, Chicago.—Kaiser Krone, Sweet Home.

John A. Salzer Seed Co., La Crosse, Wis.—Million Dollar, Salzer's Earliest, Cannon Ball, Salzer's Sunlight.

Northrup, King & Co., Minneapolis, Minn.—Ideal.

Flansburg & Pierson, Leslie, Mich.—King of Michigan.

Hiram Presley, Port Huron, Mich.—Gem of Aroostook, Free Trade, Cole's Early, 20th Century. Rosy Morn. St. Lawrence. Kaiser Krone. Columbian, Keystone, Pat's Choice. Northern Beauty, Washington, English Schoolmaster, Dew Drop, Silver Crown, Alexander.

Matt Crosby, M. A. C.—Two seedlings, Z-1, Z-2.

James J. H. Gregory, Marblehead, Mass.—Gem of Aroostook.

NOTES ON VARIETIES.

Alexander.—An early sort received from Hiram Presley, Port Huron, Mich. The vines are dark colored, stout, and averaged nearly two feet in height. The tubers showed some promising characteristics, but gave a large per cent of small ones; shape, oblong oval, a little flattened; eyes shallow, open, broad, often raised, which makes them generally smooth. The skin is pink, netted; flesh cream white, fine grained, dry, solid, mild flavored. They are very firm and appear to be good keepers for an early sort. Very promising and will be given further trial.

Astonisher.—Sent out last year by Mills as New No. 5. The yield was the same as last year. The vines are vigorous; tubers of fair quality, and attractive for a light pink sort. Of some value as a medium late variety.

Bovee.—A sample of seed was received from F. Barteldes & Co., which proved to be pure and well preserved in type. The variety was grown here for several years, and, while the quality was good, other new varieties which are better yielders have taken its place on the list.

Cannon Ball.—One of Salzer's introductions. The tubers are large, dark pink, nearly round; eyes are dark red, almost purple, deep and broad, which makes the surface appear rough. The flesh is very white, firm, and cooks floury. In the hill they are somewhat scattered, the vines and stems resembling Peachblow. They are good yielders and will ship well, but the dark color and rough appearance is against the variety as a general purpose potato in the Michigan markets.

Cole's Early, received from Presley, is an attractive looking sort with pink markings. The yield showed rather a large proportion of small potatoes, but the quality and general characteristics are promising.

Columbian.—A long, oval and slightly flattened sort. The skin is white and has the appearance of being covered with minute warts or small bunches; eyes are shallow, broad and well scattered, which gives the surface a smooth appearance. The quality is good and the firmness indicates that it is a good keeper. The vines are vigorous, upright, spreading, and grow deep, which tends to keep the tubers in the soil, thus preventing sun-burned tips.

Dew Drop.—A medium early variety; shape a little flattened, oblong, oval; skin white, with pink markings about the eyes. The eyes are narrow, of medium depth, and show very prominent seed sprouts; flesh cream white, mild flavored, a little spongy, but dry and white when cooked. The tubers are uniform and well bunched in the hill; vines vigorous, spreading well over the ground. A variety having sufficient desirable points to warrant further trial.

English Schoolmaster.—A variety having strong, branching and spreading vines. The tubers are white, marked with purple blotches or stripes, which tend to mar the appearance: shape a little irregular, but fairly smooth, oblong, flat, usually pointed at the seed end; flesh very white and firm.

Gem of Aroostook.—A seedling of New Queen introduced in 1898 by the Jerrard Seed Co. We received two lots of seed, one from Gregory, the other from Presley, of Port Huron. They were planted side by side and proved to be identical. The vines are strong growers; tubers well bunched and deep in the hill; shape oblong to long-oval, flattened: color. white with pink markings: eyes narrow, pointed, medium depth, often raised, which gives them a smooth appearance. In quality they have few superiors, and are a very attractive sort.

German Rose.—A rose-colored variety which has the markings of the old Late Rose sort. The vines are growthy; tubers are of a uniform desirable shape for baking. The quality is good.

Ideal.—A variety resembling Carman No. 3. The tubers are oval to round, slightly flattened, very white, smooth, firm, solid, of excellent quality, but lack a little in productiveness.

Junior Pride.—Vines rank and upright; tubers oval to oblong, many nearly round; skin white, with slight pink markings, finely netted. The surface is smooth; eyes broad, open, shallow; flesh white, firm, fine grained. A promising early to medium sort.

Kaiser Krone.—A white-skinned potato of the Carman No. 3 type; eyes shallow, well scattered, making the tubers smooth and of a desirable appearance. The flesh is white, very solid and fine grained. The vines are strong growers, root deeply and seem to resist attacks of the Colorado beetle. It is one of the most promising new varieties for commercial growing. A specimen of seed was received from both Vaughan and Presley, but no difference could be detected in the type.

Keystone.—Another medium late sort resembling Carman No. 3. The strongest mark of identification is the deep netted appearance of the skin. The yield was a little below the Carman, but in appearance and quality it is equal to it. Owing to its smoothness, desirable shape and color it promises to be of some value.

King of Michigan.—A variety introduced by Flansburg & Pierson, Leslie, Mich., that has strong points sufficient to class it among the desirable new sorts. The vines are vigorous, spreading well over the ground, thus shading it during the dry part of the season. The tubers are oval, elongated, slightly flattened; skin white, finely netted; eyes broad, open, shallow, evenly distributed over the entire surface. The seed markings are very prominent and strong in the eyes. The texture, flavor and grain is all that could be desired.

McKinley strongly resembles Carman No. 1. It is a good yielder and strong grower. The eyes are a little deeper, which gives is a rougher appearance than the Carman. The quality is excellent and it is a good keeping and promising market variety.

Million Dollar is another of Salzer's introductions, and gave a larger yield than any other sort in 1900. In shape and appearance they are nearly identical with Carman No. 3, but have pink markings in the eyes; skin very white, smooth, finely netted; flesh fine, floury, and of the solidity that indicates keeping qualities. This variety is certainly worthy of trial, owing to its productiveness and quality. The vines are stocky, rank growers, and very free from any symptoms of blight or tip burn.

Northern Beauty, originated by Geo. W. P. Jerrard & Co., Caribou, Maine, is of the Rose type, but is more flattened and oval than the old Early Rose. The skin is a delicate pink; eyes long, open, flat, broad and prominent; flesh cream white, fine grained, dry and floury, but a little inclined to be strong on moist soils. The vines are strong and vigorous, and the quality and productiveness are promising.

Pat's Choice, a seedling of Seneca Beauty, originated by Frank M. Kirkpatrick, of Minnesota. The tubers are long, irregular, oblong, oval, slightly flattened. The skin is white, clouded with pink, finely netted; eyes pink, small and shallow, giving it a smooth appearance; flesh is very firm and crisp, white, fine grained and floury when cooked. The firmness of texture guarantees it to be a good keeper, and the vigor of growth and appearance make it one of the desirable sorts.

Rosy Morn is an early medium variety of some promise. The tubers are regular, oblong oval, a little flattened; eyes broad, open and of medium depth, bright pink in color. The skin is light pink, nearly white, somewhat russeted; flesh white, firm and dry.

Salzer's Earliest in growth and habit is very much like the Early Ohio, but it is a red potato. The shape is slightly oblong, but nearly round; skin dark pink, thin and rubs off easily, leaving a very white, fine-grained, floury flesh of mild flavor. The eyes are small, of medium depth, with purple seed sprouts. The tubers reach edible maturity long before growth stops, and are very compact in the hill, which enables them to be planted closely, thereby increasing the yield, as they do not set as many tubers per hill as many kinds.

Silver Crown.—Well bunched in the hill; tops strong; tubers oblong round; skin white, netted; eyes of medium depth, numerous; seed sprouts are very prominent on the body of the tubers and are on raised bunches, which give the potato a little rough appearance. The flesh is white, fine grained, firm and dry. Promises to be a desirable early sort. Originated by J. R. McNarry, Burgettstown, Pa.

St. Lawrence.—A pinkish white sort of good quality. The shape is a little irregular, long, oval; eyes pink, small and shallow.

Sweet Home.—In growth and habit is identical with Carman No. 3. Very attractive, white, smooth, regular, uniform and of excellent quality. It is a good yielder and when the Carman cannot be obtained is a desirable variety.

Sunlight was the leader among the early varieties in productiveness. It is a very clear, white-skinned sort, with a netted appearance; shape long, oval, a little flattened. The eyes are strong, narrow, long and lipped, with very prominent seed sprouts, and are set in slight depressions which make the tuber appear a little rough. The quality is good and the firmness indicates that it would be a good keeper for an early sort.

Twentieth Century.—The vines resemble the Carmans in growth, but the tubers are long and tapering, usually bulged in the center; skin is cream white, covered with thick, deep nettings; eyes are coarse, medium in number and evenly distributed. The flesh is very white, firm and dry. A good yielder and appears to be a long keeper.

Washington was grown here last year, the seed having been received from the Harris Seed Co. It is a strong growing variety, good yielder, and remains solid late in the spring.

White Rose, in growth and shape, strongly resembles the old Early Rose, but the skin is clear white and has a netted appearance. The eyes are well scattered, of medium depth, rather long, broad, and slightly curtained. The quality is good, but they were a little light in yield. In a trial plot last year this was the earliest among thirty varieties.

Z-1 and Z-2 are two seedlings received from Mr. Matt Crosby that are of some promise, but need to be grown another season to be thoroughly developed. The vines are thrifty; tubers of desirable shape, white and smooth, one being a long variety, the other round.

SUMMARY.

The average yield for 1900 was better than in 1897, but it fell a little below that of 1898 and 1899. The soil was a little heavy, and during a part of the season the excessive rains made it too wet for a healthy growth.

Andes (168.45 bu.) came to edible maturity July 6, and is one of the best early sorts. It is not a strictly white potato, but is an extra early sort of superior quality.

Michigan (189.19 bu.) is the ideal white early variety. These two varieties have established their value by crops of several years.

Sunlight takes the lead among the new sorts, giving a yield of 216.75 bushels, and became edible July 4. They are of the Michigan type and certainly promise to be of some value.

Alexander (158.08 bu.) was next in yield and earliness, while Cole's Early (155.49 bu.) is another good sort.

Among the second early sorts that showed much merit are Salzer's Earliest (186.6 bu.), Northern Beauty (233.24 bu.) and Minnehaha (256.56 bu.); the latter gave a high yield, but the tubers averaged a little under size. Several of the other new sorts are of some promise, but it takes more than one season to establish their value.

Of the late kinds there are no better varieties for the general crop than Carman No. 1 or No. 3 and many of the new kinds of their type. Sir Walter Raleigh is a leader of this class.

Cannon Ball (287.66 bu.) is a large, coarse, round, red potato, and for this type of a potato is a good one.

Million Dollar (300.62 bu.) was the leader in yield and has desirable characteristics.

Kaiser Krone (228.07 bu.), Gem of Aroostook (264.33 bu.), and Pat's Choice (288.06 bu.), are three varieties of much promise and can be safely recommended as standard market sorts.

FERTILIZER EXPERIMENT.

In the spring of 1899 two acres of land, immediately north of the College, were leased for fertilizer experiments with potatoes. It had been idle for some time.

The soil is poor, being a light sand, containing but a small amount of vegetable matter, and the fact of its being non-resident property partially explains the reason for its being in such a depleted condition. It was covered with a quack grass sod that required a sharp plow and heavy horses to properly turn the furrows.

As soon as the ground was sufficiently dry in the spring it was plowed about seven inches deep and rolled with a heavy roller, then worked with spring-tooth and smoothing harrows weekly until about the first of June, when the potatoes were planted.

While preparing the soil, the roots were so numerous that it was necessary to clean the ground with a horse rake, several wagon loads of roots being drawn off and burned. Thorough shallow cultivation so nearly destroyed the grass that it caused no trouble in 1900.

The two acres were divided into 18 plots (according to plan), each containing one-tenth of an acre, with a five-foot space between the plots, to prevent the fertilizer from one plot mixing with the others by cultivation. The plots were quite uniform and with the exception of a slight depression crossing plots seventeen and eight, which was a natural drainage from farm barns in years past, there was no great difference in the mechanical condition of the soil nor the amount of fertility that it contained.

Plots 3, 7, 12, 16, were used as check plots and had no fertilizer applied to them, the other plots being treated as per plan. The fertilizers were applied a few days before planting and thoroughly worked into the soil.

The season of 1899 was rather dry for the use of commercial fertilizers, there not being sufficient moisture early in the season to properly dissolve the chemicals and make them available as plant food, hence the experiment was duplicated and repeated in 1900, with a marked increase in yields, due in part probably to the availability of last year's applications, as well as the thorough dissolving of the materials applied this season.

The question, "Does it pay to use commercial fertilizers on crops of this kind," is often asked, and in this case, from strictly a cash basis, the increase in yield did not warrant their use, but succeeding crops will certainly receive some benefit, the value of which cannot be estimated.

Other years have given results that made the use of commercial fertilizers very profitable, and the fact that they were not remunerative in these experiments should not wholly discourage their use.

In 1899 the variety planted was Herrington Peer, which has not given as large an average yield as Carman No. 3, which was used in 1900.

The growth of vines was very uniform the first year, but in the second crop there was a noticeable difference in favor of the plots that gave the largest yields.

The plots were marked three feet each way, to allow cultivation both ways on account of the excessive amount of quack grass, but in 1900 it made but a very little extra work, being so nearly killed the year before.

The seed was all treated with corrosive sublimate (1-2000) and medium-sized potatoes were cut lengthwise into four pieces, one piece being used for each hill.

The tubers were nearly free from scab, except on plots 8, 9, 17 and 18, which showed about 10 per cent scab in 1899. In 1900 plots 9 and 18 were badly affected, at least 50 per cent being worthless. This accounts in part for the small yield of those plots, as many were so badly diseased that they were a mass of decay. Nos. 8 and 17 were not as bad, but 25 per cent were unmarketable, seeming to show that compost and wood ashes favor development of the scab fungus.

The accompanying table shows the amount of fertilizers applied per acre and the yields, while the plan shows the exact arrangement of the plots, and amounts applied.

By studying the table we readily notice that the increase in yields for both years, in some instances, is a large per cent, and would repay the use of fertilizers, while comparing the check plots that had nothing applied to them with some that were fertilized, and it looks as though it was money and time thrown away.

In looking at plot XIII, which showed a large gain, but not the largest yield, we find that at the prices of the different chemicals (100 pounds sodium nitrate $2, 300 pounds of phosphate rock $2, 400 pounds of high grade dried blood $4, and 200 pounds of sulphate of potash $4, or a total of $12), the extra expense over plot XII, that had no fertilizer applied, but yielded as much within 11.7 bushels, was not repaid.

Again, by comparing plot XI, which gave 130.6 bushels, with XVI, giving only 47.1 bushels, we get a wonderful showing in favor of the fertilizers.

Notes taken as short intervals show that the growth of vines was quite uniform, although it was found that the plots showing the largest vines gave the greater yields.

DIAGRAM OF EXPERIMENTAL PLOT

I Sodium nitrate 5 lbs. High grade dried blood 20 lbs. Phosphate rock 15 lbs. Muriate potash 10 lbs.	X Sodium nitrate 5 lbs. High grade dried blood 20 lbs. Phosphate rock 15 lbs. Sulphate potash 10 lbs.
II Sodium nitrate 4 lbs. High grade dried blood 11 lbs. Phosphate rock 25 lbs. Muriate potash 10 lbs.	XI Sodium nitrate 4 lbs. High grade dried blood 11 lbs. Phosphate rock 25 lbs. Sulphate potash 10 lbs.
III Nothing.	XII Nothing.
IV Sodium nitrate 10 lbs. High grade dried blood 40 lbs. Phosphate rock 30 lbs. Muriate potash 20 lbs.	XIII Sodium nitrate 10 lbs. High grade dried blood 40 lbs. Phosphate rock 30 lbs. Sulphate potash 20 lbs.
V Sodium nitrate 8 lbs. High grade dried blood 22 lbs. Phosphate rock 50 lbs. Muriate potash 20 lbs.	XIV Sodium nitrate 8 lbs. High grade dried blood 22 lbs. Phosphate rock 50 lbs. Sulphate potash 20 lbs.
VI Potato grower 50 lbs.	XV Sodium nitrate 10 lbs. Sulphate potash 30 lbs. Ground bone 60 lbs.
VII Nothing.	XVI Nothing.
VIII Compost 2 loads	XVII Compost 1 load Sodium nitrate 5 lbs. Sulphate potash 15 lbs. Ground bone 30 lbs.
IX Compost 1 load Wood ashes 5 bu.	XVIII Sodium nitrate 10 lbs. Sulphate potash 10 lbs. Ground bone 40 lbs. Wood ashes 5 bu.

Plots 2x8 rods, 1-10 acre.

TABLE OF FERTILIZERS APPLIED PER ACRE AND YIELDS FOR 1899 AND 1900.

Plot number.	Sodium nitrate.	Ground bone.	Muriate of potash.	Sulphate of potash.	High grade dried blood.	(So. Carolina phosphate rock.) Acid phosphate.	Potato grower.	Wood ashes.	Compost.	Yield per acre, Bus., 1899.	Yield per acre, Bus., 1900.
I	50		100		200	150				61.2	86.5
II	40		100		110	250				67.3	105.6
III										52	96.83
IV	100		200		400	300				75	105.7
V	80		200		220	500				87	113.76
VI							500			53	93
VII										51	62.3
VIII									20 loads	115	122.8
IX								50 Bu.	10 loads	91.5	100.7
X	50			100	200	150				59.6	102.96
XI	40			100	110	250				72	130.6
XII										63	112.1
XIII	100			200	400	300				57	123.8
XIV	80			200	220	500				59	108.16
XV	100	600		300						44	97.4
XVI										56	47.1
XVII	50	300		150					10 loads	68	126.6
XVIII	100	400		100				50 Bu.		55	67

RADISHES, 1900.

There are many varieties sent out by seedsmen under different names that appear to be identical. In the experimental test of varieties for 1900 the seed was sown in the open ground May 3. Many of the varieties have been fully described in previous bulletins, but the following brief descriptions of new sorts are given:

Double Quick, received from Johnson & Stokes. is a quick-growing white variety. The root is long, slender, tapering, pure white. crisp, and has a mild flavor. It grows a medium amount of foliage, the mid-rib of which is of a purplish green tint.

Black Spanish, Black Summer and Black Winter are three varieties sent out by the D. M. Ferry Seed Co., of Detroit.

Black Spanish is a coarse grower, very dark colored and matures slowly. The root is crisp but peppery.

Black Winter is very much like the above, but the flavor is too strong to make it desirable.

Black Summer is of the same type, but matures quicker. It is not so long, but has a greater diameter, and there are the same objections to the quality.

Brightest Scarlet, Salzer, is a quick-growing, slender, scarlet-colored radish, very tender, crisp, and mild flavored. The tops are small.

Burlington Forcing, from Landreth, is white, turnip-shaped, and a quick grower, with a small tap root. The flesh is of a greenish white tint, crisp and mild flavored. Especially desirable for a white forcing sort.

California Mammoth, from Ferry, was one of the largest in the list. It has a large. white, crisp, and tender turnip-shaped root, with rank, coarse tops. The length of its edible period is in its favor as a summer variety, but its quality is not the best.

Cincinnati Market, Livingston, is a long, slender, crisp, white-fleshed sort. The roots are clean, symmetrical and of a bright scarlet color. As a forcing sort it is one of the best of the long varieties. The tops are small and it can be grown thickly in the beds.

TABLE OF VARIETIES.—1900.

Varieties.	Seedsmen.	Shape and color of roots.	Average.		Days to edible maturity.
			Length, Inches.	Diam., Inches.	
Double Quick	Johnson & Stokes	Long, white	5	.75	25
Black Spanish	D. M. Ferry Seed Co.	Long, black	10	1	32
Black Summer	D. M. Ferry Seed Co.	Long, black	4	1.125	32
Black Winter	D. M. Ferry Seed Co.	Long, black	12	1	36
Brightest Scarlet	Salzer	Long, scarlet	8	.75	27
Burlington Forcing	Landreth	Turnip-rooted	2	1.5	26
California Mammoth	Ferry	Long, white	12	1.5	39
Cincinnati Market	Livingston	Long, scarlet	6	.75	28
Early Long Scarlet	Ferry	Long, scarlet	8	1	32
Earliest Snow White Ice	Salzer	Turnip, white	2	1.5	23
Half Long Deep Scarlet	Ferry	Long, scarlet	4	1	28
Long Brightest Scarlet	Ferry	Long, scarlet	8	1	34
Number 8	Mills	Turnip, cardinal	3	2	30
Number 179	Buckbee	Turnip, golden yellow	2	1.5	26
Number 219	Buckbee	Turnip, scarlet	2	1.5	28
Osaka	Burpee	Long, white	10	1.25	27
Scarlet Ball	Livingston	Turnip, scarlet	3	1.25	24
Scarlet Conical	Rawson	Turnip, scarlet	2	1.5	24
Snowball	Livingston	Turnip, white	2	1.25	25
Triumph	Vick	Turnip, red and white	1.5	1.5	23
White Strasburg	Ferry	Long, white	10	1.5	32
White Vienna	Ferry	Turnip, white	1.5	1	34
4968	U. S. Dep't	Long, white	10	1	32
4997	U. S. Dep't		9.5	1.25	32
4998	U. S. Dep't		9.75	1.125	32

Early Long Scarlet, from Ferry, a long, slender, scarlet-rooted sort of desirable quality, that matures quickly.

Earliest Snow White Ice, received from Salzer, is a small, turnip-shaped, white radish of no special value. It is apt to be tough, strong and pithy.

Half Long Deep Scarlet and Long Brightest Scarlet, from Ferry, are well known standard sorts. They are among the best garden sorts, very attractive and of fine quality. The Half Long matures first, hence it is preferable for forcing, but the quality is no better.

No. 8, sent out by Mills, is a large, coarse, turnip-shaped sort, having a dark cardinal red color. The flesh is white, rather coarse, strong, and becomes pithy soon after reaching edible size. Often streaked with red. It has a peculiar sweetish flavor, but it is quite strong.

Number 179 was received from Buckbee. The leaves are small and few; root turnip-shaped; color bright golden yellow. The flesh is very white, tender, mild and quite desirable, but the color is against it as a leading sort. It has a thick skin that peels readily.

Number 219, also from Buckbee, is a thick, scarlet, turnip-rooted sort. The flesh is white, streaked with red, matures quick, and is often pithy, coarse and dry.

Osaka was received from Burpee. The leaves are very abundant, coarse and spreading; the roots are evenly tapered, white, crisp and rather strong. This variety cannot be grown close enough to be profitable.

Scarlet Ball, Livingston. A large turnip-rooted sort. The skin is bright scarlet; flesh white, tender, and of a pleasant flavor.

Scarlet Conical, from Rawson. A small-topped, turnip-rooted sort, desirable for forcing. It has a bright scarlet color and grows quickly.

Snowball, Livingston, is a white, turnip-rooted variety. The tops are too large for forcing, but the roots are firm, crisp, mild flavored, and quite desirable for out-door growing.

Triumph, Vick, is a small-topped, red and white, globe-rooted sort. Simply a novelty, and has no especial value.

White Strasburg, from D. M. Ferry & Co., is one of the best long, white sorts, and takes the place among the white varieties that Long Brightest Scarlet does among the Reds.

White Vienna, another variety received from Ferry, is a small, white, turnip-rooted sort of no special value.

Numbers 4968, 4997 and 4998 are three varieties received from the U. S. Department of Agriculture which did not develop any desirable characteristics. The tops are very large and spreading; the roots are similar to Strasburg in shape, but tough, strong and pithy. The three sorts seemed identical.

SQUASH, 1900.

Several varieties of squash were received from the United States Department of Agriculture, but only a few of them matured.

No. 4999 produced a very strong growth of running vines, but the squashes did not mature. They were oval and dark green with numerous light spots. The entire surface was covered with long, hairy spines, which gave them a peculiar appearance. The shell was thin, meat thick, green and watery, but the texture and flavor could not be determined.

LIST OF VARIETIES OF SQUASH AND PUMPKINS.

Varieties.	Seedsmen.
4976 (failed to grow)	U. S. Department of Agriculture.
4987 (failed to grow)	U. S. Department of Agriculture.
4999	U. S. Department of Agriculture.
5000	U. S. Department of Agriculture.
5001	U. S. Department of Agriculture.
5002	U. S. Department of Agriculture.
Boston Marrow	D. M. Ferry Seed Co.
Brazil Sugar	Wm. H. Maule.
Crookneck	D. M. Ferry Seed Co.
Delicata	Henderson.
Golden Bronze	W. Atlee Burpee.
Golden Custard	Henderson.
Golden Hubbard	D. M. Ferry Seed Co.
Green Mountain	D. M. Ferry Seed Co.
Hard Shell	Vaughan.
Heart O' Gold	Henderson.
Hubbard	D. M. Ferry Seed Co.
Marrow, No. 4365	U. S. Department of Agriculture.
Marrow, No. 4366	U. S. Department of Agriculture.
Marrow, Prolific	Wm. H. Maule.
Silver Custard	Henderson.
Takvorian	Takvorian.
Pumpkins.	
Golden Marrow	Wm. H. Maule.
Sugar	Henderson.
Sweet Potato	Wm. H. Maule.
Winter Luxury	Henderson.

No. 5000 was of the marrow type, but deeply ribbed, rough and warty. When mature it has a golden yellow color; shell hard; meat thick, and of a rich color. It appears to be of some value. They were from four to six inches long and had a diameter of twelve to fifteen inches. Several of them were placed in the forcing house to ripen and during the winter they matured and were quite palatable. They appear to be good keepers, but are not equal to Hubbard in quality.

No. 5001 was of the Dipper gourd type, but the handle part was enlarged to about one-half the size of the bowl. They were light green, nearly white, smooth and of various sizes.

No. 5002 was very much like No. 5000, except it was more warty, deeper ribbed and rougher. The meat appeared the same and kept equally well.

Marrow Nos. 4365 and 4366 were small, pumpkin-shaped and had no special merit. The shells were very hard, dark yellow and the meat was thick, but stringy and watery. No. 4366 was somewhat elongated, which was the only difference.

The Crookneck varieties are standards for early use and too well known to need description.

Brazil Sugar is a small, warty, light yellow, thin-shelled sort. The meat is thin, greenish yellow, tough, stringy and lacks sweetness.

The Gold and Silver Custards take the lead among the Marrows, but the Turbans are also desirable for medium sorts.

Golden Bronze and Green Mountain are of the Hubbard type and are very desirable general purpose sorts. Golden Hubbard is a choice variety. The meat is thick, dry and sweet.

PUMPKINS.

Four varieties of pumpkins were grown.

Golden Marrow, received from Maule, is a long oval, oblong sort, and is better as a field pumpkin than for garden purposes. It is a great yielder, but the meat is coarse and not as sweet for pie purposes as some of the smaller sorts.

Sugar, from Henderson, is of dark golden color, medium size, smooth, thick meated, and has a rich, sweet flavor. It is one of the best pie pumpkins. The vines are vigorous and productive.

Sweet Potato, Maule, is similar to Sugar, and has a very large, stout stem that is not easily broken off. The shell is hard and thick, but the meat is very firm, solid, fine grained and has a desirable flavor.

Winter Luxury, received from Peter Henderson & Co., is a choice variety. It is one of the larger pie sorts, bright yellow, with a netted russet covering. The shell is of medium thickness, flesh fine-grained, thick and of the highest quality. With careful handling they are long keepers, and for winter use they cannot be excelled as a pie pumpkin.

These include some of the better sorts of pie pumpkins and some of them should be grown in the garden for cooking purposes, because they are productive and much superior to the common field pumpkins.

TOMATOES, 1900.

NOTES BY R. S. NORTHROP.

The seeds for this variety test were sown in the College forcing house March 26. They were given the ordinary treatment for tomato seedlings, being twice transplanted, first into flats one inch apart each way on April 5, and next were set about 2 by 3 inches apart on April 21. On June 4, 5, 6 they were put in the field, the rows being 6 feet apart and plants 4 feet apart in the rows. The soil was a sandy loam, rich in vegetable matter.

The accompanying table shows the seedsmen from whom the seed was received, those varieties marked Dept. having been grown from seed saved at the College.

The dates of the first ripe fruits, the characters of the vines and foliage, with the average weight of an individual fruit, makes plain the relative merit of most varieties. Some of the newer varieties which have not been grown before at the College have a special description added.

The varieties Trophy, Lorillard, Best of All, Advance, Dominion Day, Ignotum and Potato leaf Ignotum were also grown in the forcing house, being trained to single stems and kept near the glass. Of these Dominion Day and Lorillard gave the best results as forcing sorts.

NOTES ON NEW VARIETIES.

Beefsteak, received from Buckbee. This was found to be a very desirable variety. The vines are of vigorous spreading habit, giving the fruit a very good chance to develop evenly and to good size. They are hardy growers and enormously productive. The fruit is of a handsome red color and even form, averaging very nearly one-half pound each.

They mature early, are a splendid shipper and good keeper, making this variety one of the best for home or market use.

Belmont, received from Gregory, was not a very vigorous grower. The vines were spreading, with small, smooth foliage. The fruit was bright red in color and fairly smooth, although somewhat irregular in shape. It matures early, the flesh is pulpy and of fair quality.

Brinton's Best is a promising variety received from Holmes. The vines are good growers and of spreading habit, having a luxuriant, small, smooth foliage, insuring uniformity in development. The fruit is of a red color, smooth and solid, and although not of the largest size is of such quality as to make this variety desirable.

Landreth's Earliest, from Landreth, much resembles Vaughan's Earliest. The vines are of vigorous spreading habit. Fruit is red, flat, rough, and somewhat larger than Vaughan's, firm and solid, but too rough to be desirable.

Early Dwarf Prolific, received from Burpee. The vines are upright in habit, have large, rough leaves and are good bearers. The fruit is small, red in color, round and smooth. It has four cells and very little pulp, making it a firm, solid tomato.

Early Michigan, received from Ferry. The vines are of medium vigor and hardiness and are quite productive. Fruit is of a bright red surface on an indistinct yellow ground. Has a medium amount of pulp, four sections, and is very smooth and nearly round.

Early Minnesota, received from Northrup, King & Co., has vines of spreading habit and medium vigor. The fruit is of considerable abundance and quite early, purple in color, of medium size, solid, smooth, and of good quality. Resembles Advance closely except for color of fruit.

Early Richmond, received from Landreth, did not prove to be very desirable. Vines are of medium vigor. Fruit is of medium size, red, rough and irregular. It has many cells, is quite thin and pulpy, and matures about mid-season.

Excelsior Purple, from Barteldes, has good vines and habit, but the fruit is thin and pulpy, making it soft and hard to handle.

First Early, from Wood & Son, has good vines of vigorous, upright habit. The fruit matures early, is of a purplish red color, smooth, round and regular in form. The meat is a little soft and pulpy with broken cells.

Fordhook Fancy, from Burpee, showed some merit. The vines lacked in vigor, but had large, healthy foliage. Fruit was of medium size and matured in good season, was round, smooth and regular, with four cells containing but a little pulp, making a firm, solid tomato easy to handle.

Kansas Standard, received from Barteldes. This is a promising new variety, having vines of the upright type, strong and vigorous, with large, rough leaves. The fruit is somewhat late, but of a good, red color, is a little ribbed, smooth at the apex, and has firm, solid flesh.

Longkeeper, received from Thorburn, has vigorous, spreading vines with good foliage. Fruit is red, smooth, round and generally regular. Of good size and appearance. The meat is solid and firm, there being four thick cells with but little pulp.

Magnus, a purple variety received from Vaughan, is of good size and quite productive. Vines are spreading, with large, rough foliage. The fruit is smooth, solid, somewhat lobed and of very good quality.

New Climbing No. 9, from Mills, as the name signifies, is a climbing variety, the vines attaining a considerable length and having a spreading habit. The fruit is somewhat below medium size, of a dull russet color, conical and smooth. The flesh and pulp are blood red. Has two cells and a large amount of pulp, making it somewhat soft.

Optimus, received from Ferry, although rather small, has some merit. It is a round, smooth, solid tomato of a good red color. Has five cells which are thick and firm, with but little pulp.

Purple Peach, from Buckbee, is a small purple variety. It has vines of medium merit, but the fruit is small, thin-celled, soft and pulpy. In shape it is round conical, has four cells and flesh which is blood red.

Quarter Century, from Burpee, has vigorous vines of the upright habit of growth. The fruit is round and flattened, a little irregular and ribbed. It has three cells, which are rather pulpy, making it soft.

Rosalind, a purple variety received from Thorburn, is an attractive grower, with vigorous, spreading vines. The fruit is large, bright purple and somewhat ribbed. The cell-walls are thick, making it solid, although it is also pulpy.

TABLE OF VARIETIES OF TOMATOES, 1900.

Varieties.	Seedsmen.	Fruit.		Average weight, pounds.	Vines.		Foliage.		
		Date of first ripe.	Color.		Height.	Habit.	Large or small.	Smooth or rough.	Margins.
Acme	Vaughan	Aug. 10	Dark Red	.227	6 ft.	Spreading	Small	Smooth.	Cut.
Advance	Department	" 11	Red	.131	4 ft., 10 in.	"	"	"	"
Atlantic Prize	Ferry	" 14	"	.166	4 ft., 8 in.	"	"	"	"
Beauty	Ferry		Red purple	.438	4 ft., 8 in.	"	"	Rough	Cut and serrate.
Beefsteak	Buckbee	Aug. 17	Red	.416	5 ft., 8 in.	"	"	Smooth.	Cut.
Belmont	Gregory	" 16	"	.143	4 ft., 1 in.	"	"	"	Cut and serrate.
Best of All	Department	" 19	"	.333	4 ft., 6 in.	"	"	"	Deeply cut.
Bright and Early	Department	" 20	"	.125	4 ft., 10 in.	"	"	"	Cut and serrate.
Brinton's Best	Holmes	" 11	"	.268	6 ft., 4 in.	"	"	"	Serrated.
Combination	Vaughan	" 24	"	.375	6 ft., 10 in.	"	Med. Small.	"	"
Conference	Department	" 15	"	.125	5 ft., 11 in.	"	Small	"	Deeply cut.
County Fair	Department	" 19	"	.375	6 ft., 8 in.	"	"	"	Cut.
Day-break	Department	" 15	"	.269	6 ft., 7 in.	"	Very large	Rough	Deeply cut.
Diadem	Department		Red and yellow	.333	4 ft., 10 in.	"	Large	Smooth.	Cut.
Dominion Day	Department	Aug. 21	"	.268	6 ft., 3 in.	"	Small	"	Finely serrate.
Dwarf Aristocrat	Vaughan	" 11	"	.200	4 ft.	"	"	Rough	Deeply cut.
Dwarf Champion	Vaughan	" 19	"	.182	3 ft., 4 in.	"	Large	"	" "
Earliest "Select"	Department	" 13	"	.250	4 ft., 3 in.	"	Small	Smooth.	Cut.
Earliest "Round"	Department	" 13	"	.250	4 ft., 3 in.	"	"	"	"
Earliest Landreths	Landreth	" 14	"	.250	6 ft., 6 in.	"	"	"	"
Early Bird	Department	" 10	"	.188	4 ft., 3 in.	"	"	"	Serrated.
Early Dwarf Prolific	Burpee	" 10	"	.100	3 ft., 2 in.	Upright	Large	Rough	Deeply cut.
Early Michigan	Ferry	" 10	"	.206	5 ft., 1 in.	Spreading	Small	Smooth.	" "
Early Minnesota	N. K. & Co.	" 11	Purple	.150	4 ft., 9 in.	"	"	"	" "
Early Richmond	Landreth	" 23	Red	.217	5 ft., 11 in.	"	"	"	Serrated.
Earliest of All	Department	" 19	"	.135	4 ft., 6 in.	"	"	"	"
Enormous	Vaughan	" 23	"	.625	6 ft., 1 in.	"	Large	Rough	Deeply cut.
Excelsior	Department	" 15	"	.237	3 ft., 2 in.	Upright	Small	"	Cut.
Excelsior Purple	Barteldes	" 23	Purple		5 ft., 2 in.	Spreading	Large	Smooth.	"
Extra Early Purple	Department	" 23	"	.137	6 ft., 1 in.	Upright	"	"	"
First Early	Wood & Son	" 14	" red	.175	5 ft., 9 in.	"	Small	"	Cut and serrate.
Fordhook Fancy	Burpee	" 20	Red	.182	3 ft.	"	Large	Rough	Deeply cut.
Freedom	Department	" 25	Yellowish red	.129	6 ft., 10 in.	"	Small	Smooth.	" "
Frogmore	Department	" 12	Red	.250	6 ft., 2 in.	Spreading	"	"	Cut.
G. A. R.	Department	" 23	"	.300	5 ft., 11 in.	"	Large	"	"
Ignotum	Vaughan	" 22	"	.333	6 ft., 2 in.	"	Small	"	Cut and serrate.
Kansas Standard	Barteldes	" 25	"	.296	3 ft., 2 in.	Upright	Large	Rough	Deeply cut.
Kuttawa Dwarf	Department	" 23	"	.333	5 ft., 10 in.	Spreading	"	Smooth.	Serrated.

Logan Giant	Department	“	24	Purple	.277	4 ft., 7 in.	Upright	Small	“	Deeply cut.
Long Keeper	Thorburn	“	25	Red	.400	5 ft., 7 in.	Spreading	“	“	Cut.
Lorillard	Department	“	23	“	.375	4 ft., 8 in.	“	“	Rough	“
Magnus	Vaughan	“	24	Purple	.500	5 ft., 2 in.	“	Large	“	“
Moore's Tree	Department	“	25	Red	.400	6 ft., 8 in.	“	Small	Smooth.	“
New Climbing	Mills	“	14	Dull russet red.	.136	7 ft., 1 in.	“	“	“	Deeply cut.
New Imperial	Maule	“	22	Red	.211	5 ft., 2 in.	“	“	Rough	Cut.
New Imperial	Department	“	23	“	.300	3 ft.	Upright	“	“	“ and serrate.
Nineteen Hundred	Maule	“	20	“	.432	4 ft.	Spreading	Large	“	“
No. 105	Department	“	21	“	.423	4 ft., 10 in.	“	“	Smooth	Deeply cut.
Optimus	Ferry	“	25	“	.166	4 ft.	“	Small	“	Cut.
Perfection	Vaughan	“	26	“	.250	5 ft., 2 in.	Upright	“	“	“
Ponderosa	Henderson	“	24	Purple red	.321	6 ft., 10 in.	Spreading	“	“	“
Ponderosa Early	Department	“	21	“	.364	6 ft., 6 in.	“	“	“	Serrate.
Potato Leaf Ignotum	Department	“	24	Red	.450	6 ft., 7 in.	“	Large	“	“
Puritan	Department	“	25	“	.350	4 ft., 6 in.	“	Small	“	Cut.
Purple Peach	Buckbee	“	15	Purple	.100	5 ft., 1 in.	“	“	“	“
Quarter Century	Burpee	“	23	Red	.208	3 ft., 7 in.	Upright	“	Rough	Serrate.
Red Pear	Buckbee	“	10	“	.033	5 ft., 2 in.	Spreading	“	Smooth.	“
Red Plum	Buckbee	“	10	“	.013	5 ft., 1 in.	“	“	“	“
Rosalind	Thorburn	“	14	Purple	.444	5 ft., 10 in.	“	“	“	Deeply cut.
Rose Peach	Thorburn	“	15	“	.100	6 ft., 1 in.	“	“	“	“ “
Royal Red	Holmes	“	16	Red	.286	6 ft., 2 in.	“	“	“	Cut.
Ruby	Department	“	20	“	.500	3 ft., 5 in.	“	“	“	Deeply cut.
Spot Cash	Department	“	23	“	.300	6 ft., 10 in.	“	“	“	Serrate.
State Fair	Department	“	18	“	.187	6 ft., 4 in.	Upright	“	Rough	Cut.
Stone	Ferry	“	19	“	.273	4 ft., 7 in.	“	“	Smooth.	“
Thorburn Novelty	Thorburn	“	10	“	.300	5 ft., 8 in.	Spreading	“	“	“
Terra Cotta	Department	“	26	Purple	.250	5 ft., 1 in.	“	“	“	“
Trophy	Department	“	23	Red	.400	6 ft., 1 in.	“	“	“	“
Trophy	Ferry	“	24	“	.300	5 ft., 6 in.	“	“	“	Deeply serrate.
Truckers' Favorite	Burpee	“	25	Purple	.378	3 ft., 5 in.	“	“	“	Cut.
White Excelsior	Ferry	“	25	“	.607	6 ft., 8 in.	“	“	Rough	“
Dwarf Golden Champion	Department	“	23	Yellow	.179	4 ft., 2 in.	Upright	Large	“	“
Egyptian Yellow	Department	“	11	“	.100	5 ft., 2 in.	Spreading	Small	Smooth	Serrate.
Golden Glory	Department	“	23	“	.375	4 ft., 10 in.	“	Large	“	Deeply cut.
Golden Prize	Department	“	23	“	.179	4 ft., 11 in.	“	Small	Rough	Cut.
Honor Bright	Ferry	“	23	Red	.266	5 ft., 1 in.	“	“	Smooth.	“
Lemon Blush	Department	“	22	Yellow	.250	5 ft., 4 in.	“	“	“	Deeply cut.
Lemon Yellow	Department	“	22	Light yellow	.131	5 ft., 8 in.	Upright	“	Rough	Finely serrate.
Shah	Department	“	11	Yellow	.301	5 ft., 6 in.	Spreading	Large	“	Deeply cut.
Yellow Peach	Burpee	“	20	“	.054	4 ft., 9 in.	“	Small	Smooth.	Cut.
Yellow Pear	Burpee	“	13	“	.029	5 ft.	“	“	“	Deeply cut.
Yellow Plum	Burpee	“	11	“	.033	4 ft., 7 in.	“	“	“	Serrate.
Yellow Prince	Department	“	21	“	.222	5 ft., 7 in.	Upright	Large	Rough	Deeply cut.
White Apple	Ferry	“	22	Whitish yellow.	.050	4 ft., 10 in.	Spreading	Small	Smooth.	Cut.
Worlds' Fair	Department	“	23	Yellow	.207	5 ft., 2 in.	Upright	Medium	Rough	Serrate.

Rose Peach, from Thorburn, although the vines are large and vigorous, has small soft fruit of no special value.

Royal Red, from Holmes, is a good grower, but fruit is small, ribbed and rough, but solid and meaty. Is not of sufficient value to be recommended.

Stone. This variety, received from Ferry, is one of the best varieties tried. The vines are of the upright class, strong and vigorous. The fruit is red, round, smooth and a little flattened. Has flesh which is solid and contains very little seed pulp, making it one of the best shipping tomatoes and also an excellent canner.

Thorburn Novelty, from Thorburn, is of vigorous, spreading habit and good foliage. The fruit is red, round, smooth and a little flattened; is of good size, has four to six cells, which are thick and contain but little pulp. The flesh is dark red.

Tucker's Favorite, from Burpee, is a purple variety. Vines are not vigorous; fruit is ribbed, soft and pulpy. Not a desirable variety.

White's Excelsior, received from Ferry, has very vigorous, strong vines. Fruit is purple, of large size and good quality. Somewhat late.

Yellow Peach, a small yellow variety received from Burpee. It is a good grower and heavy bearer. The chief use of this sort is in preserving and pickling, to which it is especially adapted by its size and quality.

White Apple is another variety belonging to the same class as the Yellow Peach, but is not as good. This was also received from Ferry. Fruit is small, round and slightly conical, of clear, yellow color, tinted with white, has two cells, which are thin and contain much pulp.

Agricultural College, Mich., March 1. 1901.

SHRINKAGE OF FARM PRODUCTS.

C. D. SMITH.

Bulletin 191.—Farm Department.

INTRODUCTION AND SUMMARY.

This bulletin is issued to place on permanent record some of the observations made from time to time at this Station and elsewhere on the subject of the gain or loss in weight of field crops between harvest and sale. The plan of the work was laid out by the late Professor A. A. Crozier, and the bulk of the observations reported below were made by him.

Wheat fluctuates in weight according to the dryness of the air. The extent of this variation, under ordinary conditions, does not exceed six per cent, but where the grain is taken from an intensely dry climate to a comparatively damp one the gain may amount to twenty-five per cent.

Oats, stored in the fall, lost in one instance over three per cent by the following May, less than two per cent in the second instance, and exactly two per cent in the third, and in a fourth lost but seven pounds in a hundred bushels.

Corn, when the entire plant is stored in the silo, suffers a very considerable loss in weight. As an average of four tests, this loss amounted to 8.32 per cent. In other cases the loss varied from 14.57 to 20.36 per cent.

When the entire plant is cured in the field, subsequent variations in weight are determined by the dryness of the air. At the Connecticut Station, where 27.36 tons of corn were cut September 1 into shocks, hauled to the barn later and stored for fodder, the gross weight was but 4.8 tons; on the 8th of February following the weight was 7.5 tons. In a duplicate test, 25.5 tons of green corn weighed but 5.2 tons on November 11, and gained to 8.5 tons by February 8.

When the corn is husked in the field the loss of weight suffered by the ears depends on their condition when hauled to the crib. Very damp corn cribbed early in October shrunk in weight 30 per cent by the middle of February, while dry corn cribbed October 21 had shrunk by the last of January 11 per cent. In another case corn very dry when hauled shrunk by New Years less than 3 per cent. At the Iowa Station the loss in an entire year was 20 per cent in one case, and 9 per cent in another.

The relation between the weights of kernels and cob does not stay constant as the ears dry. When first husked, fully 25 per cent of the weight of the ears lies in the cob. By spring, less than 20 per cent of the weight of the ear is in the cob. An elaborate set of experiments at Houghton Farm showed that the shelled corn lost in weight but about 7.45 per cent from October to March, while the cobs lost fully 36 per cent.

Two tons of fairly dry Hungarian grass seed lost 96 pounds in weight when stored in a fairly tight bin from November until the following July.

Hay, very dry timothy, stored in the mow June 27, as hauled from the field, lost but 7 per cent in six months. In another case, timothy hay lost 13.8 per cent; in a third case, the loss was 21.7 per cent, and in still another a little over 15 per cent. In the dry climate of Utah a ton of timothy hay lost a little over 15 per cent between July and April, while a stack built the same day actually gained slightly in weight. In Pennsylvania early cut timothy hay lost in the barn 29 per cent and late cut timothy hay 21.5 per cent between fall and spring.

Clover hay loses about 60 per cent from its weight when mown to the perfectly cured article. Well cured clover hay shrank, in one instance, 9 per cent by November, and in another, well cured clover hay weighed into the barn from the windrow, weighed but 3.6 per cent less in November; in still another case the loss in weight between July and February by good clover hay amounted to 11.2 per cent. A crop of clover cut in August from seed sown in March lost 22.6 per cent in weight by the following spring.

Cord wood, 18 inches long, cut from the bodies of beech trees and split into slabs, weighed 2,867 pounds per cord, on the 7th of February. It lost half its weight by the 7th of July. Between that time and the middle of October there was a loss in weight of 45 pounds per cord. There was meantime a shrinkage in bulk of about one-tenth.

WHEAT AND ITS PRODUCTS.

DUE TO OVER-RIPENING.

In 1879, Dr. R. C. Kedzie, in an exhaustive study of the ripening of wheat, pointed out that there was a slight loss in weight between complete ripeness and the stage generally designated as dead ripe. Subsequent experiments at this College and elsewhere have given like results. There is not only a loss by shelling when the grain becomes over-ripe, but a given number of well dried kernels, or the product of a given area, kept in the ordinary manner, will weigh less if taken from an over-ripe field than if taken from a field cut at the proper time. Moreover, the amount and quality of the flour produced and the germinating vigor of the grain itself are less if the wheat is allowed to become over-ripe than if cut at an early period. These facts are now well recognized by farmers, and ordinary practice is regulated by this knowledge. The loss in shelling in undoubtedly the most important one, and fortunately it can be controlled in a large measure by a proper selection of varieties combined with harvesting at the proper season.

LOSS IN WEIGHT DURING STORAGE.

In 1893, Christian Breisch & Co., millers of North Lansing, Michigan, bought of James Turner, whose farm was near Lansing, 1,500 bushels of wheat which was then in a hard, dry condition. It was hauled as soon as threshed and placed in the elevator. Ten days thereafter it was removed and found to have shrunk a little over thirty bushels. A loss of two per cent.

Again, in 1896, 900 bushels placed in the same elevator while still slightly damp shrank thirty bushels in four months. A loss of three and one-third per cent.

An experiment was performed under the supervision of Professor Hilgard of the University of California to test the actual amount of gain or loss in weight in stored grain due to the fluctuation in the moisture content of the air. Professor Wm. H. Brewer thus quotes his methods and results in the Report of the Tenth Census of the United States, Division Relating to the Cereals, page 29:

"The dried grain was spread out in a very thin layer upon a small table, standing in shallow water and covered with a bell-jar. To make the air within this space as nearly saturated as possible, filter paper, dipping into the water below, extended near the grain, but not touching it. The whole was kept at a temperature of about 64.4 degrees F. (18 degrees C.), and the grain was weighed from time to time in a corked flash to prevent loss during the weighing. Under such circumstances grain would continue to absorb moisture and increase in weight from twelve to eighteen days, the absorption being accompanied by an increase of bulk, which was not measured. The gain in weight from such absorption was as follows: In 18 days oats gained 19.8 per cent, barley 20.4 per cent, and in 14 days wheat gained 18.8 per cent. In all cases the increase was very rapid at first, then slower and slower, until about the 13th or 14th day, when a sudden increase occurred, due to the development of mold caused by the great amount of moisture present. Nearly half of the total increase occurred in the first twenty-four hours."

"He also exposed air dry grain to an absolutely dry (artificially dried) atmosphere at the same temperature, and for the same period, 18 days. The loss was at first very rapid, then slower and slower, but continued in the whole period, amounting in 18 days to 9.3 per cent for oats, 7.8 per cent for barley, and 6.2 per cent for wheat."

"According to these determinations, perfectly dry grain (artificially dried), exposed to a saturated atmosphere at a temperature of 64.4 degrees F. (18 degrees C.) for 18 days, will increase in weight as follows: Wheat, 25 per cent; barley, 28.2 per cent;

oats, 29.1 per cent. As the temperature of the interior of that state in summer is about 83 degrees F., experiments were made with dry grain at that temperature; and as the temperature increased, the amount of moisture thus lost in the given time also increased. Wheat dried in an artifically prepared atmosphere, believed to be about as dry at that which naturally occurs at harvest in the interior valleys of the state, led to the belief that the wheat cured there in the field at harvest time becomes nearly as dry as it would in an absolutely dry air, and, 'on transporting to a temperate climate may possibly increase 25 per cent, while a gain of 5 to 15 per cent may be looked for with almost absolute certainty.' The profit of this gain in weight accrues to whoever owns the grain when the absorption is going on."

Prof. W. H. Brewer began in March, 1880, a series of experiments to test the relation of wheat to the moisture of the air, putting samples of the grain in paper boxes and weighing from time to time. The boxes were but partly filled and were kept in a basket suspended from the ceiling in his office, where the air in the room freely circulated about them. The windows were kept open during the summer and until the building was heated in the fall. The office was located in New Haven, Connecticut, a seaport town, where the air was comparatively moist.

From March to September of 1880 all of the specimens gained in weight, some of them nearly six per cent; others less, according to the way they had been kept the previous winter. When weighed again in February, 1881, the wheat had shrunk to its original weight. Weighed again in September, 1881, it gained between seven and eight per cent over the weight in February.

In the report of the New York Experiment Station (Geneva) for 1884, page 79, is given the results of a laboratory experiment to test this question of the shrinkage of wheat in storage. "In the following experiment the grain was put into netting bags and suspended from the ceiling in the laboratory. Clauson wheat, harvested July 16, threshed out July 18, four bags containing 1,000 grams and two bags containing 500 grams each:

Total weight—	Grams.	Per cent of loss by drying.	Per cent water in grain.
July 18	5,000	.....	27.02
July 27	4,310.4	13.8	13.22
August 3	4,133.5	17.33	9.69
August 10	4,070.7	18.59	8.43
August 24	3,969.2	20.62	6.40
August 31	4,001.5	19.97	7.05
September 14	3,983.8	20.33	6.69
September 21	3.980.8	20.39	6.63
September 28	4,023.2	19.54	7.48
October 5	4,051.8	18.97	8.03
October 12	4.026.3	19.48	7.54
November 22	3,796.9	24.06	....

A second series, four bags of 1,000 grams each, taken from bins September 4, weighed:

Total weight—		
September 4	4,000	....
September 14	3,888.9	2.77
September 21	3,875	3.12
September 28	3,913.9	2.15
October 5	3,937.1	1.57
October 12	3,912.7	2.18
November 22	3,675	8.12

Between October 12 and November 22 the laboratory in which the samples were kept was warmed in usual manner of a dwelling room, by steam heat.

The wheat in the first table, harvested July 16, and hand threshed July 18, contained 27.02 per cent of water by analysis, and hence we have for the water content of the wheat at the various weighings the difference between the per cent of loss and 27.22 per cent, whereby we see that the lowest water content exposed to the natural air of the room was August 24, when it dried to about 6.4 per cent, and on November 22, in a steam heated room, it was about 2.96 per cent.

On September 22, and at various dates thereafter, samples were taken from a bin containing several hundred bushels, from the interior of the mass, and subjected to analysis for the purpose of obtaining the moisture. The results were:

September 22	11.96	per	cent	of	moisture.
October 13	16.57	"	"	"	"
October 23	14.62	"	"	"	"
November 1	14.17	"	"	"	"
November 12	14.84	"	"	"	"

Sanborn found in the dry climate of Utah (fourth report Utah Experiment Station, 1893, page 36) that wheat gained in total weight by winter storage, although the gain was slight.

Two experiments were tried at the Ohio Experiment Station and reported in the Eleventh Annual Report, Ohio Experiment Station, 1892, page 86. Some 20 samples of wheat from as many different varieties were put in small boxes and buried in a bin of wheat, where they remained nearly a year. After the removal of the wheat from the bin they were left in one corner without covering for two years following. The shrinkage for the three years averaged 2.32 per cent.

In another test 20 bags, each containing a bushel of wheat, were piled in a bin, in January. On weighing in July following it was found that there had been a gain of a few pounds. The season was exceptionally wet.

At this (Michigan) Station a lot of wheat was threshed on July 18, 1898. Two varieties were stored to test the shrinkage, one, the White Clauson, a soft, white variety, the other, the Buda Pesth, a hard, red sort. The grain was threshed from the shock, but was dry, in good condition for storing. The bins were in the second story of one of the College feed barns and were tight on sides and bottom but uncovered at the top. There were some evidences of the work of mice, and from one of the bins not far from four quarts of the grain leaked out. The wheat was stored 332 days. The Clauson weighed originally 3,102 pounds, and lost 14 pounds, or less than a half of one per cent; the Buda Pesth weighed 3,250 pounds, and lost but three pounds, or less than a tenth of one per cent.

It is apparent from the facts above cited that wheat, in Michigan, when well cured, contains from 10 to 13 per cent of moisture, and that a given quantity increases or decreases in weight according to the dryness of the air, the variation, except in extraordinary conditions, amounting to not more than 5 per cent.

MILL PRODUCTS.

Wheat flour exhibits the same peculiarities of oscillations in weight, responding to the moisture of the air. Experiments reported in Bulletin 4 of the Bureau of Chemistry of the Department of Agriculture, page 48, show that there may be a gain or loss of from 1 to 3 per cent on successive days by reason of a change in the moisture content of the atmosphere. In the course of a month this variation may amount to 5 per cent.

The coarser by-products of the flouring mills show a similar rise and fall in weight corresponding to the changes in the moisture content of the atmosphere. In the case of the coarse bran there was a variation of 5 per cent between the first of April and the 12th of June, although the weight was much more constant than in the case of the patent flour. The middlings had the same peculiarity of fluctuating in weight from day to day according to the dryness of the air. The following table condensed from pages 53, 54 and 55 of Bulletin No. 4, Bureau of Chemistry, Department of Agriculture will show the extent of the variations in weight from day to day; one hundred pounds of each material was weighed on the 31st of March, and the table below gives the weight of that hundred pounds on the dates mentioned:

Date.	Moisture in air, per cent of saturation, degrees.	Patent flour, lbs.	Coarse bran, lbs.	Fine bran, lbs.	Middlings, lbs.
March 31	.....	100	100	100	100
April 1	42.4	99.95	99.40	100.47	100.03
April 2	50.7	101.10	99.85	102.67	101.08
April 3	37.8	99.90	98.60	101.77	100.13
April 5	35.0	99.75	98.45	101.62	99.98
April 7	40.0	100.38	98.87	102.19	100.60
April 10	44.1	101.55	99.05	102.21	100.57
April 12	41.01	101.38	98.90	102.10	100.46
April 14	60.0	103.32	100.68	104.27	102.46
May 7	61.5	104.63	101.70	105.87	103.83
May 12	35.9	102.13	99.20	103.40	101.38
May 19	59.3	104.39	101.60	105.87	103.88
May 26	67.9	101.33	101.61	101.60	101.63
June 5	40.7	99.53	99.59	99.60	99.43
June 12	81.2	102.91	104.21	104.55	104.33
June 27	46.4	99.63	99.48	99.60	99.45

The results are instructive and show how susceptible all portions of the wheat grain are to hydroscopic conditions. One hundred pounds of flour, bran or shorts, weighed on the 31st of March, increased in weight irregularly to the 24th of May. Thereafter, to the 12th of June, the weights fluctuated within rather wide limits, reaching the minimum on the 5th of June, maximum on the 12th, and on the 22d the whole series finding a level a little below the original weight.

CORN.

Some experiments conducted at this Station in 1896 and 1897, and reported in Bulletin 154, gave interesting results bearing on the relative weights of the ears, leaves and stalks. It was found that on August 24, 24.3 per cent of the total weight of the corn plant above ground was in the ear. This per cent gradually increased until at harvest time, September 14, 35.7 per cent of the total weight of the plant was in the ear. At harvest, 46.3 per cent of the dry matter of the entire plant was found in the ear.

The experiment was repeated in 1897 with almost identical results. Nearly 47 per cent of the total dry matter of the corn plant was found in the ear. In 1897, at harvest, September 14, the ears contained 45.57 per cent of dry matter, the stalks 21.53 per cent, and the leaves 27.27 per cent. The ears were not as dry, therefore, relatively as the stalks and leaves.

THE WHOLE PLANT STORED.

An experiment was recorded in the report for the Connecticut Experiment Station for 1878, page 65, bearing on the shrinkage of the whole corn plant. Here the corn was sown in drills two feet apart, three bushels of seed to the acre. The crop made a good growth and was ten to twelve feet high at harvest, although the ears were mostly nubbins, with a few well matured ears. Below are given the results of two separate trials the same season:

	Crop 1.		Crop 2.	
September 1—	Lbs.	Tons.	Lbs.	Tons.
Freshly cut	54,723	27.36	51,074	25.5
Containing water	47,184	23.59	43,413	21.70
November 11—				
Field cured	9,583	4.8	10,454	5.2
Containing water	2,644	1.3	2,799	1.4
February 8—				
In barn	15,028	7.5	16,988	8.5
Containing water	8,089	4.	9,327	4.7
Actual dry matter	6,939	3.5	7,661	3.8

The fall weather was exceptionally dry and the fodder in the field became very well cured with a water content of 27 per cent, while the stover on Mr. Webb's farm in 1877 contained 36 per cent.

The fodder was stored loosely in the barn to favor further drying and curing. The winter was warm and damp and they absorbed moisture from the air to such an extent that the average five tons of fodder as stored November 11, became eight tons as it lay in the barn February 8.

In 1896 and 1897 experiments with ensiloing corn at the Michigan Station gave some data as to the shrinkage of corn when preserved in the silo. In the first place, corn cut at different dates had the following per cents of moisture:

August 10	82.69 per cent.
August 25	79.13 " "
September 6	72.51 " "
September 15	65.14 " "

These successive weights show the gradual drying out of the corn plant during ripening. In the same experiment the corn was weighed into the silos and the silage weighed out, thus giving data to determine the loss in weight. These losses averaged for four silos 8.32 per cent of the weight of the corn as it was put in the silo.

This loss in the silo is, of course, not althogether a disappearance of the water. The Wisconsin Experiment Station has carried on a series of valuable experiments to determine the nature and extent of the changes that take place in the silo. Incidentally, indications are given of the per cent of loss in gross weight that takes place between putting the corn in the silo in the fall and taking it out in the winter. In seven cases the losses were respectively, 12.69 per cent, 20.52 per cent, 15.54 per cent, 10.90 per cent, 12.05 per cent, 14.18 per cent, and 15.48 per cent, making an average of 14.48 per cent.

Reference to page 462 of Bulletin 154 of this Station will show that the loss of dry matter of the whole corn plant as put in the silo varies from 14.67 per cent to 20.36 per cent. The amount of loss is contingent upon the condition of the corn at the time it is put in the silo and upon the construction of the silo itself. As farmers are becoming better acquainted with the right principles of construction of farm buildings, the per cent of loss in silos gradually diminishes.

The Ears.—In Michigan, corn is usually cut and placed in shocks as soon as the kernels have become hard, and before the stalks and leaves have been injured by frost or have lost their greenness by reason of maturity. It is allowed to stand in the shock until fully cured, before husking. After husking, the corn in the ear is usually allowed to lie upon the ground for a few days to dry still further before being cribbed. It is obvious that the amount of shrinkage or loss in moisture of the corn in the crib will depend on the weather and on the condition of the corn at the time it is hauled from the field. In the fall of 1896, October 3 and 5, six loads of corn, amounting to 16,767 pounds, were placed in a crib to determine shrinkage. Most of the corn was hauled as soon as husked, as the weather was damp and rainy. The corn, therefore, was damp and heavy when hauled, and in some cases actually wet with dew or rain. On February 13 following, the corn was again weighed and found to have lost 5,725 pounds, or a little over 30 per cent. This is an extreme case, as the corn was unusually damp when placed in the crib.

October 21, 1895, 3,310 pounds of ears were hauled from the field in a fairly dry condition on a damp day. The corn was left in the sack until January 23, when it had lost 359 pounds, or nearly 11 per cent.

In the same season, on the farm of Wm. S. Charles, Van Buren county, 26,975 pounds of well cured corn which had been put in cribs in the fall was weighed out January 6 and 7 and found to have lost only 770 pounds, or a little less than 3 per cent.

In Breeders' Gazette for 1895, pp. 504, Henry T. Meigs, of Tippecanoe county, Ohio, reported that on December 15, 1894, he weighed into a rail pen 25,445 pounds of yellow corn and 19,170 pounds of white corn. At the end of ninety days the yellow corn weighed 23,660 pounds, a loss of 1,785 pounds, a little over 7 per cent. The white corn was sold August 16 following, when it had lost in weight nearly 15½ per cent.

An extensive experiment was performed in 1894-95 in central Illinois and reported substantially as below in the Rural New Yorker for 1895, p. 725.

Last summer Messrs. N. D. Ricks, W. N. Provine and George E. Maxson, joint owners of a tract comprising 6,000 acres in Christian county, Illinois, decided to determine how much corn shrinks when husked and cribbed under ordinary conditions in that section. To this end they erected in the center of the tract mentioned a double crib 26 feet wide, 250 feet long and ten feet high at the eaves, with a driveway 8 feet wide through the center and a good tight roof over all. Near one end of this crib a small office was built and a set of standard scales put in. Husking began October 22 and ended December 17. Every day while it was going on Mr. Maxson remained at the office, and all the corn that went into the crib was weighed and recorded. The quantity put in footed up 16,155 bushels of 70 pounds each. The corn was finally sold to be delivéred early the following July. At that time Mr. Maxson again took charge of the scales and weighed the corn as it came out of the crib. It was also weighed at the elevator, the total weight at the two places varying but a few pounds. The corn weighed 14,896 bushels and 40 pounds when taken out, showing a total shrinkage of 1,258 bushels, or a small fraction less than 7¾ per cent. When husking began the grain was considered to be in fair cribbing condition. Very little rain fell during the winter, only a few showers in March and April, while May and June were very dry.

In the fall of 1898 a series of experiments were begun at the Iowa Experiment Station to test the shrinkage of corn in the ear. The results of the first year are reported in Bulletin 45 of that Station. There was weighed into a crib 13.5 feet long by 7.5 feet wide, built on a scale so that weights could be taken whenever desired, 7,000 pounds of corn in the ear. The corn was weighed from time to time and the shrinkage noted.

The loss for the first three months was 630 pounds, of 9 per cent; the second three months recorded a loss of 390 pounds, or over 5.5 per cent; the third three months gave a loss of 220 pounds, over 3 per cent; in the whole year the loss was 1,430 pounds, or slightly over 20 per cent.

The experiment was repeated the following year and the results reported in Bulletin 55. The 7,000 pounds of corn shrank 400 pounds between October 19 and January 19; the loss for the entire year was 635 pounds, the lowest weight being on August 9. This was a shrinkage of 9 per cent. At the end of the year the kernels of corn contained 12.14 per cent of water and the cob 25.82 per cent.

The Shelled Corn.—In the report of the Connecticut Experiment Station for 1880 the analyses of sixty-three samples of corn show a water content varying from 6 to 15 per cent. Prof. Johnson remarks that the water in maize kernels and maize meal as these are found in the market may range from 13 to 22 per cent; well cured corn and meal contain from 15 to 17 per cent, while new corn and the meal ground from it are liable to contain over 20 per cent.

Prof. W. H. Brewer remarks (Tenth Census, Statistics of Agriculture, The Cereals, p. 105), "Corn and corn meal have been articles of export since colonial days. The two things that have operated most against its export were the vulgar prejudices against its use among the poorer classes abroad until of very late years, and the difficulties of shipping it in good condition. The grain, when fresh, contains a larger amount of water than other cereals. It is harvested later in the year, when it does not dry out so readily, and the kernels are larger and dry more slowly than other grains. It is liable to come to market containing from 15 to 20 per cent of water, and to mould or at least to be injured on the voyage.

When once thoroughly dry the weight of corn fluctuates with the moisture in the air.

Prof. Brewer shows in the article just quoted, p. 31, that an amount of corn which weighed 100 pounds in February, 1881, weighed in the September previous and in the September following from 105 to 107 8-10 pounds.

At the Houghton Farm, in 1881, Dr. Manly Miles performed some experiments on the effects of various manures on the corn crop, and incidentally tested the question of the shrinkage of corn and cob during the winter. He had 31 plots under investigation. He weighed the ears at the time of harvest, in October, 1881, shelled part of them at once, and determined the weight of shelled corn and cob in October. The remainder of the corn was left in the ear until March, 1882, when it was shelled, and the weight of shelled corn and cobs determined. The experiments were performed on two distinct areas—the first 15 plots were called the west plots, and the remaining 16 the north plots. As far as they relate to the question of shrinkage, the essential facts brought out by the experiment were as follows: On the north plots, 55,553 pounds of ears, as harvested in October, 1891, gave 41,399 pounds of shelled corn, or 25.47 per cent of cobs. In the following March, when the corn was shelled, but 19.84 per cent of the gross weight of the ears was cobs. On the west plots, 48,830 pounds of ears gave 35,342 pounds of shelled corn, or 27.62 per cent of cobs. In March following the per cent of cobs on the west plots was found to be 19.70.

The 55,553 pounds of ears harvested on the north plots weighed in March 47,819 pounds, a shrinkage of 13.92 per cent. On the west plots the 48,830 pounds of ears had shrunk by the next March to 40,699 pounds, a shrinkage of 16.65 per cent.

The shelled corn on the north plots weighed 41,399 pounds in October and but 38,328 pounds in March, a shrinkage of 7.41 per cent. On the west plots the 35,324 pounds of shelled corn shrank to 32,680 pounds, a loss of 7.49 per cent.

The cobs on the north plot weighed in October 14,154 pounds, and in the following March 9,491 pounds, a shrinkage of 32.94 per cent. On the west plots, the cobs weighed in the fall 13,506 pounds, and in the following spring 8,019 pounds, showing a shrinkage of 40.62 per cent.

Taking the averages of these per cents of shrinkage, we find that the ears shrank during the winter an average of 15.28 per cent. The shelled corn, 7.45 per cent, and the cobs an average of 36.78 per cent. In absolute number of pounds the cobs lost in weight on the west plots 5,487 pounds, while the shelled corn, while weighing two and one-half times as much, lost but 2,644 pounds, or less than half as great a loss as that suffered by the cobs. In the same way on the north plots, the loss in weight by the cobs was 4,663 pounds, while the shelled corn lost but 3,071 pounds.

Among the many lessons taught by these figures one certainly is that if a definite number of pounds of corn in the ear is to be recognized as a bushel a wise farmer will sell his crop in the fall.

OATS.

Oats when threshed, after passing through the sweating process in the stack or now, appear to shrink but little thereafter. At the Ohio Station in September, 1892, 4,243 pounds of recleaned oats were put up in ordinary grain sacks. There were fifty-four varieties in the lot, some of which were in small amounts so that not all of the sacks were full. These oats were kept all winter in a room artifically warmed, and in the following March were again weighed with a loss of only 29½ pounds, or less than 1 per cent.

At the Michigan Station 100 bushels of oats, 3,200 pounds, were weighed into a bin August 11, 1896, without recleaning and within an hour after threshing. They were in fairly dry condition, although they had been wet with rain while in the shock. On the 18th of March following they were weighed out and showed a total loss in weight of only seven pounds.

September 13, 1897, 806 pounds of International oats and 550 pounds of New Marine oats were weighed and placed in a bin in the sheep barn at the College farm. When removed the following March the International oats had shrunk but 13 pounds and the New Marine but 11 pounds.

On the 8th of October, 1899, 1,038 pounds of oats were weighed into a fairly tight bin in the Experiment Station barn, where they remained until the 10th of May, 1900, when they weighed but 1,003 pounds, showing a shrinkage of 3.4 per cent.

HAY.

Hay, when put in the mow, varies greatly in the amount of moisture it contains, depending on the weather in which it is cured. In the dry climate of the west the shrinkage is usually smaller than in a comparatively humid climate of the eastern states.

At the Kansas Experiment Station, in 1888, 13 kinds of hay were put in muslin bags and buried in mows of hay from four to six months. The shrinkage averaged 4.5 per cent, ranging from a 14 per cent loss to a gain of 3 per cent.

At the Michigan Station, on the 27th of June, 1896, five tons of very dry timothy hay was drawn from the field and, after weighing, was placed in the barn in a mow, separated from the rest of the hay in the barn. It was later temporarily covered with grain in the straw. Six months later, on the 26th of January, it was removed and found to have lost 684 pounds, or nearly 7 per cent.

Again, on the 6th of July, 1898, 5,600 pounds of timothy hay, in good condition to draw to the barn, was placed in a separate mow in the College barn. It was weighed out February 18, 1899, when it was found to have lost 776 pounds, or 13.8 per cent.

In the summer of 1887, Mr. C. B. Charles, of Van Buren county, put in a barn 130.5 tons of timothy hay in good condition. "In the following January," he says, "I baled out 100.5 tons, while the chaff, dirt and short hay fed to my sheep from under the press amounted to 1.5 tons. This indicates a shrinkage of 28.5 tons, or 21.7 per cent." In this case undoubtedly the hay was riper than the lot used at the Michigan Station, and was probably not as dry when put in the barn.

Mr. H. E. Emmons, formerly a dealer in hay in Detroit, writes: "Hay, from the time of putting in the mow until it is sold or baled out, shrinks not far from 20 per cent. After baling each bale further shrinks from 1 to 4 pounds."

At the Utah Station (Fourth Annual Report, p. 36), one ton of timothy hay stored in the barn July 20, 1892, and weighed out April 20 following, lost 314 pounds, or a little over 15 per cent. A stack containing 4,565 pounds was built out of doors the same day and weighed again on the 21st of April following, when it showed an increase to 4,635 pounds, a gain of over 1 per cent. At the same station a ton of clover hay placed in the barn July 15, 1892, and removed April 20 following, lost 75 pounds, or 3.75 per cent. A stack of clover hay, 4,090 pounds, built July 15, was again weighed April 21 following, when it had gained 10 per cent, or up to 4,528 pounds.

At the Missouri Station 5,678 pounds of timothy was stacked as drawn from the field. When weighed the following spring, it had shrunk to 4,972 pounds, a loss of about 12.5 per cent. From the same field there was placed in the barn 4,183 pounds of timothy hay, which weighed the next spring 3,893 pounds, a loss nearly 7 per cent. At the same station, a stack of second growth clover, weighing in July, when put up, 6,514 pounds, shrank in weight to 4,548 pounds, a loss of 30 per cent, by the following March.

At the Michigan Station, on August 31 and September 1, 1896, there was placed in the barn 6,110 pounds of hay made from clover sown in the spring of 1896. The growth had been very succulent, but the hay was well cured. On the 6th of February following, during a period of damp weather, it was taken out and weighed, and found to have lost 22.6 per cent. A portion of it was musty when reweighed.

The degree of maturity at which hay is cut, as well as the condition of the weather, has much to do with the amount of shrinkage to be expected during curing. Early cut hay contains more food value for a given weight undoubtedly, but later cutting gives a larger yield per acre of cured hay. At the Pennsylvania Station grass cut when nearly ripe weighed when cured and put in the barn 11 per cent more than hay from an equal area cut when in the blossom. The early cut hay lost in the barn on an average of 29 per cent in weight, while the late cut hay lost but 21.5 per cent.

The actual amount of shrinkage during the curing varies between wide limits. Clover cut at the usual time shrinks a little over half in curing into hay. In 1897, at this Station, 4,691 pounds of green clover made 1,960 pounds of cured hay, a shrinkage of nearly 60 per cent. It was reweighed the following November, showing a farther loss of 180 pounds, or 9 per cent of the weight when put in the barn. A writer in the Country Gentleman reports that 1,520 pounds of green clover made 680 pounds of hay, or over 44 per cent of hay.

In July, 1897, at this Station, 1,100 pounds of clover hay containing a little timothy was put in the barn directly from the windrows, being unusually dry for hauling from the field. It was reweighed November 12 following, when is showed a loss of but 398 pounds, or 3.6 per cent.

Again, on the 6th of July, 1898, 5,763 pounds of Mammoth Clover hay, that had been fairly well cured the day before and kept in the heap over night in the field, and hauled to the barn at 9 a. m., was stored in one of the large bays in the Station barn. The hay had been very dry when raked. On the 18th of February, 1899, the hay weighed 5,117 pounds, showing a shrinkage of 646 pounds, equivalent to 11.2 per cent in the seven months.

Wallace, in his book on clover, says that 100 pounds of green clover cut at the proper time and well cured will make 47 pounds of hay, and that this will shrink in 20 days after storing to 37 pounds. Clover cut before the usual time will shrink much more than this. In June, 1896, at this Station, 1,870 pounds of half grown crimson clover shrank during the process of curing to 418 pounds, making but a little over 20 per cent of hay.

The shrinkage of timothy when cut at different dates was found by Prof. W. H. Jordan at the Pennsylvania Station to be as follows: When cut just as the heads are beginning to appear timothy lost, on an average, in curing into hay, 75 per cent of water. When beginning to bloom, the loss was 66 per cent, and when somewhat past blossom, about the usual time of cutting, the loss was 57 per cent.

At the New York, Geneva, Station, a mixture of meadow fescue with a little red clover lost in one lot 62.68 per cent, and in another lot 58.25 per cent during the process of curing.

The amount of moisture retained in cured fodder varies with different kinds. Prof. Atwater concludes that for New England timothy hay retained on an average 12 per cent of moisture; clover hay, 14 per cent, and corn fodder 25 per cent.

HUNGARIAN GRASS SEED.

Four thousand pounds of Hungarian grass seed was weighed into a tight bin November 14, 1896. On the 10th of July, 1898, it weighed but 3,904 pounds, a loss of 2.8 per cent.

CORD WOOD.

Seasoned wood, besides being lighter to haul and handle than green wood, brings a better price, since it is ready for immediate use. Some of the questions to consider in the storage and sale of wood are first the loss in weight in seasoning, and second the shrinkage in bulk. The following experiments bearing on the above point were conducted at this Station in 1896 and 1897.

On February 7, 1896, 5 cords of freshly cut green beech 18-inch slab body wood weighed 14,336 pounds, or 2,867 pounds per cord. It was then piled one cord high in a single rack, with free exposure to the sun and air. On the 7th of July following it weighed 7,372 pounds, a shrinkage of nearly one-half. The pile, meantime, had settled about two and a half inches. After weighing, the wood was repiled, when it was found that the five cords had shrunk one-third of a cord in bulk. It was then allowed to stand undisturbed until October 19, when it weighed 7,148 pounds, or a little less than one-half its weight when green. The season had been an unusually wet one, although there was no rain for several days preceding these weighings. This experiment seems to teach that body beech wood split into slabs loses about one-half its weight in seasoning, and nearly one-tenth its bulk.

Ten cords of 18-inch beech and maple slab wood, cut the preceding winter, was split and piled in July. It then measured exactly 11 cords.

C. D. SMITH.

Agricultural Colloge, Mich., May 7, 1901.

FERTILIZER ANALYSES.

BY R. C. KEDZIE.

Bulletin 192.—Chemical Department.

The law providing for the inspection of commercial fertilizers and to regulate their sale in this State was enacted in 1885: The law has been reprinted in these Bulletins several times, but as there are so many new dealers and consumers who want to know the exact words of the law, it is again printed for the information of the public.

[*Act No. 26 of the Session Laws of 1885.*]

The People of the State of Michigan enact:

Section 1. Any person or persons who shall sell or offer for sale in this State any commercial fertilizer, the retail price of which exceeds ten dollars per ton, shall affix on the outside of every package containing such fertilizer a plainly printed certificate, stating the number of net pounds therein; the name or trade mark under which such article is sold; the name of the manufacturer; the place of manufacture, and a chemical analysis, stating the percentage of nitrogen in an available form; of potash soluble in water and of phosphoric acid in available form, soluble or reverted) and the insoluble phosphoric acid.

Sec. 2. Before any commercial fertilizer is sold or offered for sale, the manufacturer, importer or party who causes it to be sold or offered for sale within this State, shall file with the Secretary of the State Board of Agriculture a certified copy of the analysis and certificate referred to in section one, and shall also deposit with said secretary a sealed glass jar containing not less than two pounds of such fertilizer, with an affidavit that it is a fair sample of the article thus to be sold or offered for sale.

Sec. 3. The manufacturer, importer, or agent of any commercial fertilizer, the retail price of which exceeds ten dollars per ton as aforesaid, shall pay annually to the Secretary of the State Board of Agriculture, on or before the first day of May, a license fee of twenty dollars for each and every brand of fertilizer he offers for sale in this State: Provided, That whenever the manufacturer or importer shall have paid this license fee his agents shall not be required to do so.

Sec. 4. All such analyses of commercial fertilizers required by this act shall be made under the direction of the State Board of Agriculture and paid out of the funds arising from the license fees provided for in section three. At least one analysis of each fertilizer shall be made annually.

Sec. 5. The Secretary of the State Board of Agriculture shall publish in his annual report a correct statement of all analyses made and certificates filed in his office together with a statement of all moneys received for license fees, and expended for analysis. Any surplus from license fees remaining on hand at the close of the fiscal year shall be placed to the credit of the experimental fund of said board.

Sec. 6. Any person or persons who shall sell or offer for sale any commercial fertilizer in this State without first complying with the provisions of sections one, two, and three of this act, or who shall attach or cause to be attached to any such package or fertilizer an analysis stating that it contains a larger percentage of any one or more of the constituents or ingredients named in section one of this act than it really does contain shall, upon conviction thereof, be fined not less than one hundred dollars for the first offense, and not less than three hundred dollars for every subsequent offense, and the offender shall also be liable for damages sustained by the purchaser of such fertilizer on account of such misrepresentation.

Sec. 7. The State Board of Agriculture by any duly authorized agent is hereby authorized to select from any package of commercial fertilizer exposed for sale in this State, a quantity, not exceeding two pounds, for a sample, such sample to be used for the purposes of an official analysis and for comparison with the certificate filed with the Secretary of the State Board of Agriculture and with the certificate affixed to the package on sale.

Sec. 8. All suits for the recovery of fines under the provisions of this act shall be brought under the direction of the State Board of Agriculture.

Approved March 10, 1885.

OBJECT OF INSPECTION OF COMMERCIAL FERTILIZERS.

The law does not prescribe any standard for the composition of a commercial fertilizer, the manufacturer being free to make his own standard, the law simply requiring that the fertilizers offered for sale shall be up to the standard set up by the manufacturer. The license to sell does not certify to the value of the fertilizer, but simply states that the manufacturer or dealer offers for sale a fertilizer for which a certain content of nitrogen, potash and phosphoric acid is claimed, and that samples of such fertilizers have been deposited with the secretary of the college with affidavit regarding the composition. Analysis is then made of each of these fertilizers, gathered in the open market as far as possible, and the results of such analysis published in bulletin. The *claimed* composition and *found* composition are arranged in parallel lines, so that the real composition can be compared at a glance with the composition claimed for it by the manufacturer. In this way the buyer can see at once by this bulletin whether the fertilizer is as good as the claims made for it. The materials to be determined in such analysis are "nitrogen in available form, potash soluble in water, phosphoric acid in available form, and the insoluble phosphoric acid." The chemists of Europe and America have selected these same materials as determining the chief value of commercial fertilizers, and in every state of our union where the law prescribes chemical analysis of commercial manures as one condition of sale, these are the materials to be determined as the basis of value.

These are not the only materials concerned in raising crops, *but they are the only materials for which the farmer can afford to pay more than ten dollars a ton.*

LEADING KINDS OF FERTILIZERS.

The leading kinds of fertilizers may be classified as follows:

1. *Complete Manure,* which contains nitrogen in some combination, such as a salt of ammonia, nitrate of soda, or organic nitrogen; potash, as muriate or sulphate (German Stassfurth salts) or wood ashes; and phosphoric acid as a phosphate of lime. It is called a complete manure because it contains all of the three materials most essential for plant growth, and most likely to be deficient in a field after long cropping.

2. *Plain Phosphate,* which may be in the form of superphosphate, soluble in water or solution of citrate of ammonia, these being called available, because they are readily taken up by the roots of plants; and ground phosphate rock, an insoluble form. The bone phosphate and rock phosphate are changed into superphosphate by the action of sulphuric acid, removing a part of the lime, as sulphate.

The soluble phosphate is especially beneficial to plants in the early state of their growth, giving them a good start. In later stages of growth when the plant by its roots can forage for food in the soil, the insoluble phosphate may have nearly as beneficial an effect.

Phosphates promote the formation of flower and fruit and secure earlier ripening. They may wisely be used on vines and succulent fruits that are liable to be cut by early frosts in autumn, securing early crops with better prices and avoiding the loss of the entire crop by untimely frosts before the most of the crop had ripened. Fruit trees sometimes blossom year after year without producing fruit. This is often caused by storms at the period of flowering, but it may be caused by constitutional weakness, in consequence of which pollen of vital power is not formed. In such cases the use of active phosphates is worthy of trial.

3. *Bone Meal* contains phosphate of lime and animal matter rich in nitrogen, and hence is very valuable for manure where we desire a prolonged influence. It is well

adapted to grass lands and lawns, and is free from the bad odor often given off by mixed fertilizers. Moist meadows are benefited by a dressing of bone meal. If the bones that now adorn the back yard and pasture lot should be ground into a powder and scattered on a crop-worn field, the results would surprise some farmers.

4. *Potash Manure.* The best and cheapest is that neglected home product—wood ashes. These contain an average of 5 per cent of potash, besides a sensible amount of phosphate, and a very large amount of carbonates of lime and magnesia: they are an all-round plant manure so far as mineral matter is concerned, supplying each ash element.

Unless the farmer can bring into active form the great store of potash in his soil, he will then have to buy the German potash salts, the muriate or sulphate. These salts are yearly coming into greater prominence as potash fertilizers, but their sale in Michigan in separate form has not been large.

The influence of potash on plant life is masterful; no plant can grow without it, and its influence in developing the carbohydrates, and maturing fruits, is marked and apparently controlling.

5. *Nitrogen Compounds.* Nitrogen is the bottled wine of the vegetable feast. If the term stimulant can be applied to any organization destitute of a nervous system, then nitrogen is the stimulant of plant life. In any of its combined forms it gives depth of color and exuberance of growth to vegetable life, and when in abundant supply it causes the plant to break forth into riotous growth. The great reservoir of nitrogen is the air, but the leaves of plants though constantly bathed in nitrogen, cannot drink in a particle. It is only *nitrogen in combination* that can be appropriated by the plant, and this enters the plant by the roots and comes from the soil. A small amount is brought to the soil by the rain, washing out the ammonia and nitrates of the air, but the amount is not large and entirely inadequate to supply a crop.

A large amount of active nitrogen in the form of nitrates is yearly formed in every well cultivated field, and this is the cheapest way of securing a supply of this costliest element of plant growth. The raising of leguminous crops, like the clovers, is the next cheapest way of securing a supply.

Combined nitrogen is purchased in three forms: salts of ammonia, nitrate of soda and organic nitrogen in the form of dried blood, fish scraps, cotton seed meal, etc.

6. *Tankage,* is a complex and variable material obtained from the waste residues at the slaughter houses, the garbage collected by the scavengers in cities, etc. These materials are dried, the grease extracted in tanks and this tankage by itself, or mixed with phosphates, potash, etc., is sold as a fertilizer. It is mainly used to give bulk to the concentrated fertilizers made from bone and rock phosphate.

SCHEDULE OF COMMERCIAL PRICES.

The following prices per pound for fertilizing materials may be used in estimating the commercial value:

	Per pound.
Nitrogen in nitrates	$0 13
Nitrogen in ammonia salts	14
Organic nitrogen in meat, blood, etc	14
Organic nitrogen in fine bone and tankage	13½
Organic nitrogen in medium bone and tankage	10
Organic nitrogen in coarse bone and tankage	8
Phosphoric acid, available	4½
Phosphoric acid, insoluble, in fine bone and tankage	4
Phosphoric acid, insoluble, medium bone and tankage	3½
Potash as muriate	4½
Potash as sulphate and in wood ashes	5

COMMERCIAL VALUE AND AGRICULTURAL VALUE.

The commercial value and the agricultural value are not identical. The commercial value merely represents the cost of the material to make the fertilizer, if any one should attempt to make his own. The agricultural value or the benefit from the use of such fertilizer will depend upon a variety of conditions, such as the kind of soil, the crop, the season, the tillage, time of application, etc., etc. Let no one suppose that the estimate of the commercial value is a guarantee of a corresponding profit by its use on the farm. It may serve, however, as a basis of comparison between different brands of fertilizers. The reliable test of the value is determined by its use on a given soil and crop—worth more than all theoretical discussions and deductions. Yet there are certain general considerations which go to show the probable benefit of any fertilizing element when used on a certain kind of soil and crop, which will be of some benefit in selecting a fertilizer.

TERMS EXPLAINED.

In the table giving the results of analysis of commercial fertilizers there are certain terms used which require explanation: "Available nitrogen, estimated as ammonia;" under "Phosphoric acid" the terms "Available P_2O_5;" "Insoluble P_2O_5;" "Total P_2O_5" and "Potash soluble in water, estimated as K_2O."

Nitrogen may exist in available form either as a salt of ammonia, a nitrate, or in organic material such as dried blood, and be equally valuable in these several forms. But for ease of comparison in different manures chemists estimate it as if all these forms of nitrogen existed in the form of ammonia. Chemists estimate the compounds of phosphorus in manures as anhydrous phosphoric acid, P_2O_5; that is, phosphoric acid deprived of water; when this anhydride combines with water, the acid is formed. Thus if three molecules of water are added to one of P_2O_5 two molecules of phosphoric acid are formed $3H_2O + P_2O_5 = 2H_3PO_4$ = phosphoric acid. The P_2O_5 in separate form does not exist in any soil, but this expression is chosen because the amount of this combination of phosphorus is easily indicated, without considering what material the acid may be combined with. "Available P_2O_5" signifies the per cent of the acid in a form directly usable by the plant: "Insoluble P_2O_5," the per cent of acid in the condition of phosphate rock. By adding together the "Available" and "Insoluble" we get the "Total P_2O_5."

The "Potash soluble in water, estimated as K_2O," is the soluble potash salt estimated only as regards the oxide of potassium = K_2O=oxide of kalium or potassium.

SELECTING SPECIMENS OF FERTILIZERS FOR ANALYSIS FOR THE BULLETIN.

The law requires the manufacturer or dealer to deposit a specimen of each fertilizer with the secretary of the board, but such specimens are never used for analysis unless it is impossible to obtain specimens from the material exposed for sale in the open market. The object is to deal with the same material that the farmer buys for himself. In this way any collusion by which a richer fertilizer is analyzed than will be found in the fertilizer offered for sale in the open market, is prevented.

As the fertilizers arrive at somewhat uncertain periods and are distributed over a wide extent of territory, the gathering of the specimens requires much travel and time in order to cover the whole area of fertilizer consumption.

The following stations and names of the dealers give some idea of the thoroughness with which this work is done. It is not feasible to visit every dealer, but the aim is to go over the more important districts for the specimens.

Some of the parties visited on the fertilizer collection from May 6 to June 20.

West Bay City.—Geo. L. Mosher, E. S. Fitch, Geo. L. Frank.

Bay City.—Rechlin & Frank, Jenison Hardware Co., R. C. Bialey, Boutell Bros. & Co., Presley & Layer, F. W. Bradfield, F. C. Goddene.

Saginaw.—Saginaw Hardware Co., John P. Derby, H. M. Neumann, C. W. Bruske, Popp & Wolfe, Walz Hardware Co.

Caro.—C. E. Mudge, Caro Elevator Co., Caro Sugar Co., T. W. Van Tine.

Fair Grove.—H. W. Houghtaling, Mitchill & Co., Richardson Elevator Co.

Bad Axe.—J. G. Wright, Meridith & Ryckman, Comfort Produce Co., Wm. Rapson & Sons, Lankin & Dundas, A. T. McDonald, W. H. Carey.

Ubly.—H. J. Wilkson, G. W. Sparling, John Cope, D. H. Pierce & Sons, Thomas Richardson.

Carsonville.—Hartzhorn & Anderson.

Sanilac Center.—E. A. McPherson, Wm. Roberts, Walker & Coughell, Dell T. Dawson.

Port Sanilac.—R. Godfrey, Wm. Greening.

Imlay City.—F. Booth, Walter Walker, Sleeman & Burkholder, Andrew Wood, John W. Green, Marshall Bros.

North Branch.—Daniel Orr, Wm. Butler, Martin Fay, W. W. Harrington, North Branch Grain Co.

Lapeer.—Spury Pike & Co., White & Hevener, Ainsworth Bros., M. Carey, Barsto & Gas, J. A. Porter, R. King, E. S. Roberts.

Flint.—T. W. Hubbard, Goodes & Hall, Smith Carriage & Harness Co., R. Putnam & Co.

Battle Creek.—Rathburn & Kraft, Barney & Kirkpatrick, T. J. Mack, John Linihan, W. A. Wattles, Weedlock Mills, V. C. Wattles, J. H. Stiles, Karnen Bros., W. M. Dibble, Rupert & Morgan.

Marshall.—Udell Bros., Hubbard & Beckwith.

Homer.—F. E. Strong Bros., Frank Mount, Snyder & Tillotson.

Hillsdale.—G. N. Smith, G. F. Gardner, C. E. Lawrence Co., Fred Swartz, E. H. Cunningham, L. C. Wright, S. B. Shank, Joe Cornell.

Reading.—Hartwell & Doig, S. B. Mallery, E. P. Kidder, Bartholomew & Cain, Geo. Woodham, W. M. Cahow, Burlingame & Browning.

Coldwater.—Chandler Hardware Co., V. L. Nettleton, Kerr Bros., G. A. Randolph, S. Pallock & Son, G. W. Harding, Reed & Johnson, S. I. Treat & Son.

Sturgis.—Favorite & Schermerhorn, Cressles & McKarlie, E. C. Wright, H. S. Church, F. H. Bailey.

Kalamazoo.—Geo. W. Parker, P. F. Ackley, G. R. & I. Grain Elevator, W. P. Darling, J. F. Farnham, H. H. Boylan & Son, A. F. Woodham Coal Co.

Vicksburg.—J. C. Van Tassel, E. C. Rishel, J. F. Young, Vicksburg Lumber Co.

Cassopolis.—H. E. Moon, O. Alexander, Atkins & Bros., Haden & Reagan, Coulter & Higley, Dunbar & Alexander.

Niles.—P. Stockweather & Co., G. S. Bolton & Co., A. Williams, J. S. Tuttle, J. L. Reddick, W. E. Platt, John A. Montague.

Dowagiac.—Vrooman & Son, Owen Hardware Co., F. H. Reshore, G. E. Bishop, Schmitt Bros., Vrooman & Son.

South Haven.—J. S. Mabone & Son, Fisher & Smith, C. S. Mills, John Mackey, John Gill, M. J. Merrifield.

Hartford.—Downey & Co., Blashfield & Smith, Mortimer & Son, Bennett & Sons, O. M. Smith.

Benton Harbor.—W. P. Robbins, C. H. Worril & Co., H. H. Lawrence, W. C. Harvey, J. S. Baker, J. F. Sterling, Stevens & Morton, W. R. Heath.

Holland.—M. Witvlet, Jacob Flieman, J. Cole, Evart Takken, A. Harrington, Walsh & DeRoo Milling Co., Kanters & Standart, John Nies Hardware Co., H. Walsh, T. Keppler's Sons.

Zeeland.—J. P. DePree & Sons, Wm. VanSlooten, John Pyl, P. J. VerHags, Henry DeKruif.

Grand Haven.—N. Robbins, Hancock & Sons, Speidel & Schwartz, Kooiman Bros.

Muskegon.—John Albers, People's Hardware Co., Towner Hardware Co., Hoogstraat & Niel, Hanson & DeMoor, Fortenbecher Bros., D. M. Roy, Karel & Decker, P. J. Connell & Co., L. H. Kanitz.

Howell.—J. Moore.

Lenox.—Patterson & Lovejoy, Farmers' Elevator Co.

Romulus.—Thomas McClaughry, R. J. Bird.

Milan.—H. I. Stewart.

Pittsfield.—John Regetz.

Denton.—J. B. Schlicht.

Rochester.—E. S. Letts, Detroit Sugar Co.

Imlay City.—John W. Green, Marshall Bros.

St. Joseph.—B. F. Pixley, Frank M. McOmber.

Wayne.—Edward Hall, Wm. Green.

Utica.—Lewis Stead.

Clawson.—Geo. Robinson.

Dundee.—W. S. Wells.

Jackson.—S. M. Isbell, James Boland.

Bad Axe.—W. H. Carey.

Sanilac Center.—Dell Dawson.

Caro.—T. W. Van Tine.

Hudson.—Dunham & Son, Kurt Rhead.

Mt. Clemens.—Allen Houghten.

Petersburg.—E. W. Spencer, Clark Cilly, Clark Belding.

Royal Oak.—Jacob Erb.

Ypsilanti.—O. E. Thompson & Son.

Monroe.—Sieb & Baier.

Ida.—Frank Younglove, J. E. Snell, Shaffer Bros., Foraker & Younglove.

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Abbott & Martin Rendering Co., Columbus, Ohio	Bone, Meat and Blood Guano	S. P. Powell, Brown City
Abbott & Martin Rendering Co., Columbus, Ohio	Ideal Grain Grower	S. P. Powell, Brown City
Armour & Co., Chicago, Ill	Acidulated Bone Meal	B. F. Pixley, St. Joseph
Armour & Co., Chicago, Ill	All Soluble	Vrooman & Son, Dowagiac
Armour & Co., Chicago, Ill	Ammoniated Bone with Potash	L. F. Jones Seed Co., Grand Rapids
Armour & Co., Chicago, Ill	Bone, Blood and Potash	Dunbar & Alexander, Cassopolis
Armour & Co., Chicago, Ill	Bone Meal	B. F. Pixley, St. Joseph
Armour & Co., Chicago, Ill	Fruit and Root Crop Special	Mohr Hardware Co., West Bay City
Armour & Co., Chicago, Ill	Grain Grower	Mohr Hardware Co., West Bay City
Armour & Co., Chicago, Ill	High Grade Potato	John Gill, South Haven
Armour & Co., Chicago, Ill	Phosphate and Potash	Mohr Hardware Co., West Bay City
Armour & Co., Chicago, Ill	Star Phosphate	Dunbar & Alexander, Cassopolis
Armour & Co., Chicago, Ill	Sugar Beet Special	Henry De Kruif, Zeeland
Armour & Co., Chicago, Ill	Wheat, Corn and Oats Special	Dunbar & Alexander, Cassopolis
The American Agricultu'l Chemical Co., New York City	Bradley's Alkaline Bone with Potash	Manufacturer
The American Agricultu'l Chemical Co., New York City	Bradley's B. D. Sea Fowl Guano	J. B. Schlicht, Denton
The American Agricultu'l Chemical Co., New York City	Bradley's Dissolved Bone with Potash	E. S. Letts, Rochester
The American Agricultu'l Chemical Co., New York City	Bradley's Niagara Phosphate	J. B. Schlicht, Denton

for 1901, expressed in parts in a hundred.

	Available nitrogen, estimated as ammonia.	Phosphoric acid.			Potash soluble in water, estimated as K_2O.
		Available.	Insoluble.	Total.	
Claimed	1 to 2	8 to 10	2 to 3	10 to 13	4 to 5
Found	1.00	9.07	2.76	11.83	2.52
Claimed	1 to 2	8 to 10	2 to 3	10 to 13	1 to 2
Found	1.00	10.09	3.79	13.88	.74
Claimed	2 to 3	11 to 14	7 to 10	18 to 24	...
Found	3.56	9.85	5.54	15.39	...
Claimed	3.5 to 4.5	8 to 10	2 to 4	10 to 14	4 to 5
Found	3.69	11.84	1.31	13.15	5.90
Claimed	3 to 4	6 to 8	2 to 4	8 to 12	2 to 3
Found	2.69	7.57	2.48	10.05	2.37
Claimed	5 to 6	8 to 10	2 to 4	10 to 14	7 to 8
Found	4.64	8.63	1.39	10.02	7.36
Claimed	3 to 4	...	...	24 to 28	...
Found	4.17	7.65	15.59	23.24	...
Claimed	2 to 3	8 to 10	2 to 4	10 to 14	5 to 6
Found	2.25	8.52	2.60	11.12	3.88
Claimed	2 to 3	8 to 10	2 to 4	10 to 14	2 to 3
Found	2.55	7.30	6.09	13.39	2.21
Claimed	2 to 3	8 to 10	2 to 4	10 to 14	10 to 12
Found	2.07	8.42	1.45	9.87	10.28
Claimed	...	10 to 12	2 to 4	12 to 16	2 to 3
Found	...	13.01	.84	13.85	2.31
Claimed	...	14 to 16	2 to 4	16 to 20	...
Found	...	14.29	1.90	16.19	...
Claimed	1.06 to 2.12	8 to 10	2 to 4	10 to 14	4 to 5
Found	2.88	8.67	.84	9.51	4.62
Claimed	1.06 to 2.12	7 to 9	2 to 4	9 to 13	1 to 2
Found	1.70	10.31	2.82	13.13	1.04
Claimed	...	11 to 13	1 to 2	12 to 15	2 to 3
Found	...	10.72	1.50	12.22	1.84
Claimed	2.5 to 3.5	8 to 10	2 to 3	10 to 13	1.5 to 2.5
Found	2.52	9.16	.96	10.12	1.93
Claimed	1.2 to 2.4	8 to 10	2 to 3	10 to 13	2 to 3
Found	1.28	8.23	2.09	10.32	2.13
Claimed	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2
Found	1.34	8.47	1.27	9.74	1.49

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
The American Agricultu'l Chemical Co., New York City	Bradley's Soluble Dissolved Bone	Manufacturer
The American Agricultu'l Chemical Co., New York City	Cleveland Dryer Works—Horsehead Phosphate	Manufacturer
The American Agricultu'l Chemical Co., New York City	Cleveland Dryer Works—Phospho Bone	Wm. Greening, Port Sanilac
The American Agricultu'l Chemical Co., New York City	Cleveland Dryer Works—XXX Phosphate	John W. Green, Imlay City
The American Agricultu'l Chemical Co., New York City	Crocker's Ammoniated Bone Superphosphate	Patterson & Lovejoy, Lenox
The American Agricultu'l Chemical Co., New York City	Crocker's Ammoniat'd Wheat and Corn Phosphate	J. Moore, Howlett
The American Agricultu'l Chemical Co., New York City	Crocker's Dissolved Bone and Potash	P. J. Ver Hage, Zeeland
The American Agricultu'l Chemical Co., New York City	Crocker's General Crop Phosphate	Patterson & Lovejoy, Lenox
The American Agricultu'l Chemical Co., New York City	Crocker's New Rival Ammoniated Superphosphate	Patterson & Lovejoy, Lenox
The American Agricultu'l Chemical Co., New York City	Crocker's Universal Grain Grower	P. J. Ver Hage, Zeeland
The American Agricultu'l Chemical Co., New York City	Farmers' Union Club and Grange Formula	H. L. Stewart, Milan
The American Agricultu'l Chemical Co., New York City	Farmers' Union Dissolved Bone and Potash	Wm. Cole, Bankers
The American Agricultu'l Chemical Co., New York City	Farmers' Union Potato, Tobacco and Truck Manure	H. L. Stewart, Milan
The American Agricultu'l Chemical Co., New York City	Farmers' Union Standard Phosphate	John Regetz, Pittsfield
The American Agricultu'l Chemical Co., New York City	Niagara Dissolved Bone and Potash	Manufacturer
The American Agricultu'l Chemical Co., New York City	Niagara Grain and Grass Grower	Burlingame & Browning, Reading
The American Agricultu'l Chemical Co., New York City	Niagara Wheat and Corn Producer	T. McClaughry, Romulus
The American Agricultu'l Chemical Co., New York City	William & Clark, Dissolved Bone and Potash	Manufacturer

for 1901, expressed in parts in a hundred.

	Available nitrogen, estimated as ammonia.	Phosphoric acid.			Potash soluble in water, estimated as K_2O.
		Available.	Insoluble.	Total.	
Claimed	....	14 to 16	1 to 2	15 to 18	....
Found	....	14.01	.88	14.89	....
Claimed	....	10 to 12	....	10 to 12	....
Found	....	8.37	2.01	10.38	....
Claimed	1 to 2	10 to 12	....	10 to 12	1 to 1.5
Found	1.22	10.12	3.14	13.26	1.29
Claimed	....	14 to 16	....	14 to 16	....
Found	....	13.69	1.29	14.98	....
Claimed	3 to 4	9 to 11	1 to 2	10 to 13	2 to 3
Found	2.92	9.73	1.89	11.62	2.43
Claimed	2.5 to 3.6	8 to 10	1 to 2	9 to 12	1.5 to 2.5
Found	2.42	9.71	.67	10.38	2.17
Claimed	....	10 to 12	1 to 2	11 to 14	1 to 2
Found	....	7.35	1.78	9.13	1.88
Claimed	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2
Found	1.23	6.62	1.70	8.32	1.01
Claimed	1.5 to 2.5	9 to 11	1 to 2	10 to 13	2 to 3
Found	1.92	8.10	2.46	10.56	1.86
Claimed	1 to 2	8 to 10	1 to 2	9 to 12	2 to 3
Found	1.17	8.08	1.84	9.92	2.42
Claimed	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2
Found	1.09	6.74	1.52	8.26	1.43
Claimed	....	10 to 12	1 to 2	11 to 14	2 to 3
Found	....	9.34	1.95	11.29	1.75
Claimed	2.5 to 3.6	8 to 10	1 to 2	9 to 12	3 to 4
Found	2.69	8.91	.64	9.55	2.91
Claimed	1.5 to 2.5	9 to 11	1 to 2	10 to 13	2 to 3
Found	1.63	8.67	2.30	10.97	2.11
Claimed	....	10 to 12	1 to 2	11 to 14	2 to 3
Found	....	10.37	1.66	12.03	1.98
Claimed	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2
Found	2.23	7.76	1.38	9.14	1.88
Claimed	1.5 to 2.5	9 to 11	1 to 2	10 to 13	2 to 3
Found	1.63	8.49	2.27	10.76	1.74
Claimed	....	10 to 12	1 to 2	11 to 14	2 to 3
Found	....	10.23	1.89	12.12	1.75

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
The American Agricultu'l Chemical Co., New York City	Williams & Clark, Prolific Crop Producer	Geo. L. Frank, West Bay City.
The American Agricultu'l Chemical Co., New York City	Williams & Clark, Royal Bone phosphate	Geo. L. Frank, West Bay City
James Boland, Jackson	Blackman	James Boland, Jackson
Chicago Fertilizer Co., Chicago, Ill.	Bone, Blood and Potash	Edmund Hall, Wayne
Chicago Fertilizer Co., Chicago, Ill.	Standard Truck and Tobacco Fertilizer	Lewis Stead, Utica
Chicago Fertilizer Co., Chicago, Ill.	Wheat Special	Frank Younglove, Ida
The Cincinnati Phosphate Co., St. Bernard, Ohio	Dissolved Bone and Potash	O. W. Braman, Grand Rapids
The Cincinnati Phosphate Co., St. Bernard, Ohio	Grain and Grass Grower	E. Wilse, Saginaw
The Cincinnati Phosphate Co., St. Bernard, Ohio	Superphosphate	Manufacturer
The Cincinnati Phosphate Co., St. Bernard, Ohio	Wheat Grower	Frank Wickham, Atlas
Darling & Co., Chicago	Chicago Brand	Dell Dawson, Sanilac Center
Darling & Co., Chicago	Farmers' Favorite	Dell Dawson, Sanilac Center
Darling & Co., Chicago	Pure Ground Bone	Dell Dawson, Sanilac Center
Darling & Co., Chicago	Sure Winner	Dunham & Son, Hudson
Darling & Co., Chicago	Two and Twenty Bone	T. W. Van Tine & Co., Caro
Darling & Co., Chicago	Western Brand	Allen Houghten, Mt. Clemens
Detroit Sanitary Works, Detroit, Mich	Clover Leaf	William Greene, Wayne
Grand Rapids Glue Co., Grand Rapids, Mich	G. R	Perkins & Hess, Grand Rapids.

for 1901, expressed in parts in a hundred.

	Available nitrogen, estimated as ammonia.	Phosphoric acid.			Potash soluble in water, estimated as K_2O.
		Available.	Insoluble.	Total.	
Claimed	1 to 2	7 to 9	1 to 2	8 to 11	1 to 2
Found	1.11	6.82	1.77	8.59	1.05
Claimed	1.2 to 2.4	8 to 10	2 to 3	10 to 13	2 to 3
Found	1.28	7.64	1.54	9.18	2.14
Claimed	1.14	3.86	2.06	5.94	2.51
Found	.94	3.27	2.57	5.82	3.62
Claimed	1.5 to 2.5	8 to 11	2 to 3	10 to 14	2 to 4
Found	1.74	9.33	2.23	11.56	2.23
Claimed	3 to 5	8 to 10	1 to 2	9 to 12	4 to 6
Found	2.55	7.70	2.27	10.97	4.01
Claimed	1 to 2.5	8 to 11	1 to 2	9 to 13	1 to 2
Found	1.19	7.21	2.02	9.23	1.07
Claimed	....	12 to 14	1 to 2	13 to 16	3 to 4
Found	....	12.40	2.91	15.31	2.68
Claimed	1 to 2	10 to 12	1 to 2	11 to 14	1 to 2
Found	1.11	8.97	4.43	13.40	1.55
Claimed	....	12 to 14	1 to 2	13 to 16	....
Found	....	12.33	.76	13.09	....
Claimed	....	14 to 15	1 to 2	15 to 17	....
Found	....	10.01	3.07	13.08	....
Claimed	2 to 3	8 to 10	2 to 4	10 to 14	2 to 3
Found	2.31	8.91	5.66	14.57	3.47
Claimed	3 to 4	8 to 10	2 to 4	10 to 14	4 to 5
Found	3.72	8.40	5.04	13.44	5.48
Claimed	3 to 4	....	....	24 to 26	....
Found	3.17	7.06	18.10	25.16	....
Claimed	1 to 2	8 to 10	2 to 4	10 to 14	3 to 4
Found	1.39	7.31	5.41	12.72	3.61
Claimed	2 to 3	....	....	18 to 22	....
Found	2.33	3.14	15.27	18.41	....
Claimed	½ to 1	7 to 9	1 to 1	8 to 10	½ to 1
Found	.83	6.94	3.98	10.92	.65
Claimed	3 to 4½	9 to 11	1 to 2	10 to 13	3 to 4
Found	2.82	7.77	3.46	11.23	3.26
Claimed	5.45 to 6	6.5 to 8.5	3 to 4	9.5 to 12.5	....
Found	5.02	4.82	8.93	13.75	....

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Hardy Packing Co., Chicago, Ill....	Crop Producer..................	E. W. Spencer, Petersburg.....
Hardy Packing Co., Chicago, Ill...	Ft. Dearborn Phosphate.........	E. W. Spencer, Petersburg.....
Hardy Packing Co., Chicago, Ill....	Wheat Grower..................	E. W. Spencer, Petersburg.....
Jarecki Chemical Co., Sandusky, O.	C. O. D. Phosphate.............	H. H. Boylan & Son, Kalamazoo
Jarecki Chemical Co., Sandusky, O.	Lake Erie Fish Guano..........	Jacob Erb, Royal Oak..........
Jarecki Chemical Co., Sandusky, O.	Number One Fish Guano.......	Shaffer Brothers, Ida...........
Joseph Lister, Chicago..............	Pure Bone Meal....	W. R. Heath, Benton Harbor...
Frank N. McOmber, St. Joseph, Mich..............................	Meat and Bone..................	Frank N. McOmber, St. Joseph
Michigan Carbon Works, Detroit..	Banner Dissolved Bone	Jenison Hardware Co., Bay City..........................
Michigan Carbon Works, Detroit..	Desiccated Bone................	Clark Cilley, Petersburg........
Michigan Carbon Works, Detroit..	Homestead. A Bone Black Fertilizer	Sieb & Baier, Monroe ....
Michigan Carbon Works, Detroit..	Homestead Potato and Tobacco Fertilizer.............	Sieb & Baier, Monroe ....
Michigan Carbon Works, Detroit..	Red Line Complete Manure....	Sieb & Baier, Monroe ....
Michigan Carbon Works, Detroit..	Red Line Crop Grower..........	Clark Cilley, Petersburg........
Michigan Carbon Works, Detroit..	Red Line Phosphate............	O. E. Thompson & Sons, Ypsilanti..........................
Michigan Carbon Works, Detroit..	Red Line Phosphate with Potash	R. J. Bird, Romulus............
Northwestern Fertilizer Co., Chicago, Ill..........................	Acidulated Bone	Thomas Richardson, Ubly......
Northwestern Fertilizer Co., Chicago, Ill..........................	Acidulated Bone and Potash...	E. F. Good, Davison............

for 1901, expressed in parts in a hundred.

	Available nitrogen, estimated as ammonia.	Phosphoric acid.			Potash soluble in water, estimated as K_2O.
		Available.	Insoluble.	Total.	
Claimed	1 to 3	8 to 10	1 to 2	9 to 12	1 to 1¾
Found	1.39	8.14	2.11	10.25	3.29
Claimed	....	13 to 15	1 to 2	14 to 17	....
Found	....	12.81	4.89	17.70	....
Claimed	½ to 2.5	8 to 10	1 to 2	9 to 12	2.5 to 3.5
Found	1.01	9.48	2.04	11.52	2.75
Claimed	....	14 to 15	1 to 2	15 to 17	....
Found	....	15.50	.79	16.29	....
Claimed	2 to 3	10 to 11	1 to 2	11 to 13	1 to 2
Found	2.52	8.78	3.20	11.98	1.25
Claimed	1 to 2	10 to 11	1 to 2	11 to 13	1 to 2
Found	1.45	9.74	2.71	12.45	1.69
Claimed	3.3 to 4.8	11.5 to 15	12.1 to 15.08	23.6 to 30	....
Found	3.04	6.87	19.34	26.21	....
Claimed	6.30	8.85	....	8.85	.17
Found	5.24	4.62	3.76	8.38	.26
Claimed	....	30 to 32	....	30 to 32	....
Found	....	26.16	4.75	30.91	....
Claimed	1.5 to 2.5	....	....	25 to 30	....
Found	1.70	8.33	20.61	28.94	....
Claimed	2.5 to 3.5	8 to 11	....	8 to 11	1.5 to 2.5
Found	2.57	9.19	.68	9.87	1.84
Claimed	2.5 to 3.5	8 to 11	....	8 to 11	3 to 4
Found	2.92	8.72	.74	9.46	3.74
Claimed	1 to 2	7 to 10	....	7 to 10	1 to 2
Found	1.39	8.19	2.34	10.53	1.52
Claimed	2 to 3	8 to 10	....	8 to 10	2 to 3
Found	2.57	7.46	1.61	9.15	2.21
Claimed	....	14 to 16	....	14 to 16	....
Found	....	10.06	1.43	11.49	....
Claimed	....	10 to 12	....	10 to 12	2 to 3
Found	....	10.53	1.95	12.48	2.95
Claimed	1 to 2	10 to 12	2 to 3	12 to 15	....
Found	1.23	9.56	2.64	12.20	....
Claimed	1 to 2	10 to 12	2 to 3	12 to 15	1 to 1.5
Found	1.21	9.81	2.34	12.15	1.36

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Northwestern Fertilizer Co., Chicago, Ill	Corn and Wheat Grower	J. E. Snell, Ida
Northwestern Fertilizer Co., Chicago, Ill	Garden City Superphosphate	Thomas Richardson, Ubly
Northwestern Fertilizer Co., Chicago, Ill	Potato Grower	Stevens & Morton, Benton Harbor
Northwestern Fertilizer Co., Chicago, Ill	Quick Acting Phosphate	Thomas Richardson, Ubly
Ohio Farmers' Fertilizer Co., Columbus, Ohio	Ammoniated Bone and Potash	A. L. Bragg, Petersburg
Ohio Farmers' Fertilizer Co., Columbus, Ohio	Corn, Oats and Wheat, Fish Guano	A. L. Bragg, Petersburg
Ohio Farmers' Fertilizer Co., Columbus, Ohio	General Crop Fish Guano	Geo. Robinson, Clawson
Ohio Farmers' Fertilizer Co., Columbus, Ohio	Potato and Tobacco Special	Geo. Robinson, Clawson
Speidel & Schwartz, Grand Haven, Mich	Celery Hustler	Speidel & Schwartz, Grand Haven
Swift & Co., Chicago, Ill	Ammoniated Bone	A. F. Woodham Coal Co., Kalamazoo
Swift & Co., Chicago, Ill	Ammoniated Bone and Potash	Patterson & Lovejoy, Lenox
Swift & Co., Chicago, Ill	Bone and Potash	Vicksburg Lumber Co., Vicksburg
Swift & Co., Chicago, Ill	Bone Meal	W. H. Carey, Bad Axe
Swift & Co., Chicago, Ill	Complete Fertilizer	Marshall Bros., Imlay City
Swift & Co., Chicago, Ill	Diamond Phosphate	E. J. Merrifield, South Haven
Swift & Co., Chicago, Ill	Onion Grower	S. M. Isbell & Co., Jackson
Swift & Co., Chicago, Ill	Onion and Potato Special	Kurt Rhead, Hudson
Swift & Co., Chicago, Ill	Potato and Tobacco Grower	S. M. Isbell & Co., Jackson

for 1901, expressed in parts in a hundred.

	Available nitrogen, estimated as ammonia.	Phosphoric acid.			Potash soluble in water, estimated as K_2O.
		Available.	Insoluble.	Total.	
Claimed	2 to 3	8 to 10	2 to 3	10 to 13	2 to 2.5
Found	2.18	7.26	2.02	9.28	2.16
Claimed	2.5 to 3.5	8 to 10	2 to 3	10 to 13	1.5 to 2
Found	2.58	8.69	.82	9.51	1.94
Claimed	3 to 4	9 to 10	2 to 3	11 to 13	2 to 3
Found	2.63	8.67	.89	9.56	1.65
Claimed	....	10 to 12	2 to 3	12 to 15	....
Found	....	11.24	2.65	13.89	....
Claimed	1 to 2	8 to 10	2 to 3	10 to 13	4 to 6
Found	2.86	9.33	2.33	11.66	6.88
Claimed	1.5 to 2.4	8 to 10	2 to 3	10 to 13	2 to 4
Found	3.81	9.48	3.24	12.72	3.37
Claimed	1 to 2	8 to 10	2 to 3	10 to 13	1 to 2
Found	1.07	10.14	2.44	12.58	.80
Claimed	3 to 4.1	8 to 10	2 to 3	10 to 13	4 to 6
Found	3.43	8.15	1.10	9.25	4.19
Claimed	8.4 to 9.6	.69 to 1.41	3.17 to 3.4	3.86 to 4.81	1.25 to 2.4
Found	8.40	1.70	1.79	3.49	1.89
Claimed	6 to 7.2	....	....	17 to 18	....
Found	5.12	5.75	13.14	18.89	....
Claimed	5.75 to 7	....	....	16 to 17	3
Found	2.63	10.22	3.00	13.22	2.25
Claimed	3 to 3.9	....	....	23½ to 26	3.00
Found	3.06	7.59	15.94	23.53	3.59
Claimed	3 to 3.9	....	....	25 to 27½	....
Found	3.57	7.24	18.28	25.52	....
Claimed	1.2 to 2.12	8 to 10	3 to 5	11 to 15	1 to 2
Found	1.48	8.52	2.53	11.05	1.27
Claimed	....	10 to 12	1 to 2	11 to 14	....
Found	....	10.27	.78	11.05	....
Claimed	3 to 4	8 to 10	3 to 5	11 to 15	7 to 8
Found	3.66	6.11	.49	6.60	7.12
Claimed	2 to 3	8 to 10	3 to 5	11 to 15	7 to 8
Found	2.28	8.62	3.42	12.04	3.88
Claimed	3.9 to 4.8	10 to 12	1 to 3	11 to 15	5 to 6
Found	4.24	9.09	.37	9.46	5.25

Results of analysis of commercial fertilizers

Manufacturer.	Trade name.	Dealer and locality.
Swift & Co., Chicago, Ill.	Pure Acid Phosphate	Manufacturer
Swift & Co., Chicago, Ill.	Raw Bone Meal	W. H. Carey, Bad Axe
Swift & Co., Chicago, Ill.	Special Potato Fertilizer	Manufacturer
Swift & Co., Chicago, Ill.	Sugar Beet Grower	Detroit Sugar Co., Rochester
Swift & Co., Chicago, Ill.	Superphosphate	W. S. Wells, Dundee
Swift & Co., Chicago, Ill.	Vegetable Grower	S. M. Isbell & Co., Jackson

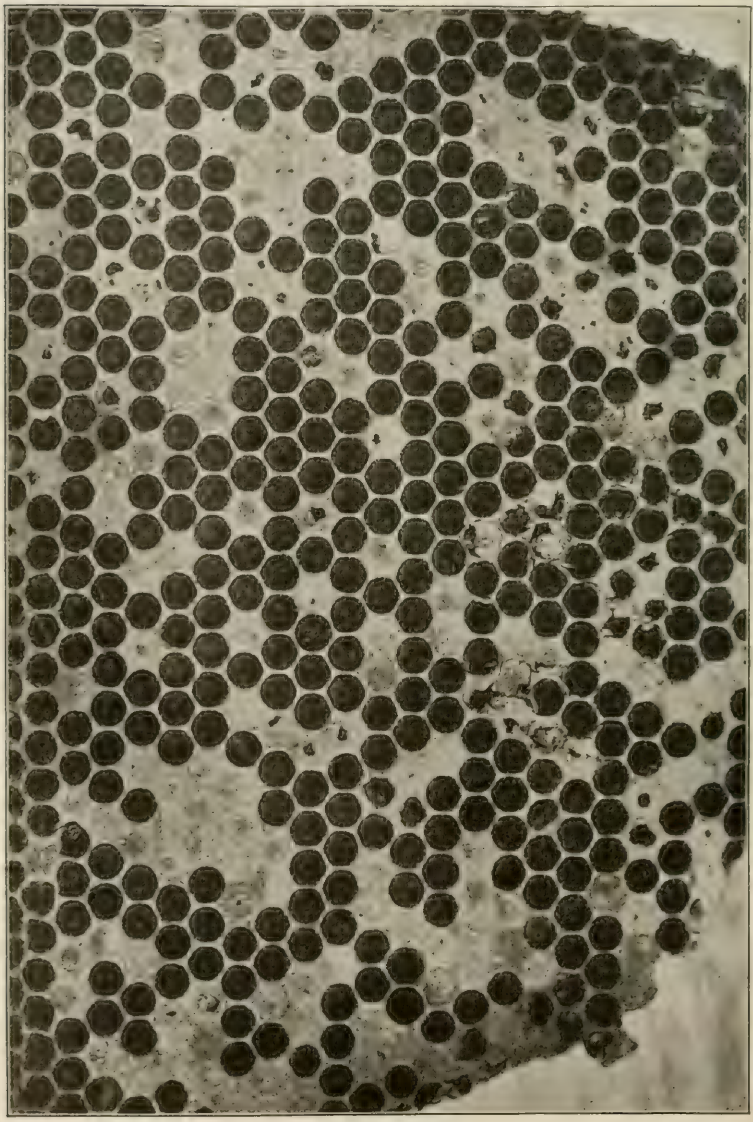
for 1901, expressed in parts in a hundred.

	Available nitrogen, estimated as ammonia.	Phosphoric acid.			Potash soluble in water, estimated as K_2O.
		Available.	Insoluble.	Total.	
Claimed	....	16 to 18	1 to 2	17 to 20	....
Found	....	14.91	1.00	15.91	....
Claimed	4.5 to 5.4	....	....	23 to 27½	....
Found	5.17	6.32	17.16	23.48	....
Claimed	3 to 4	10 to 12	3 to 4	13 to 16	3 to 4
Found	3.74	9.75	.35	10.10	3.14
Claimed	3 to 4	8 to 10	3 to 5	11 to 15	5 to 6
Found	3.11	10.45	3.35	13.80	5.24
Claimed	2.1 to 3.9	8 to 10	4 to 8	12 to 18	2 to 3
Found	2.77	7.58	1.47	9.42	2.48
Claimed	3.9 to 4.8	9 to 11	1 to 3	10 to 14	10 to 11
Found	3.58	8.75	.36	9.11	8.70

FOUL BROOD.

BY C. D. SMITH AND J. M. RANKIN.

Special Bulletin 14.—Agricultural Department.



SECTION OF COMB INFECTED WITH FOUL BROOD.

Foul brood is a disease of bees common in all parts of the State of Michigan and one which is fast ruining a most pleasant and profitable industry. It spreads through an apiary, affecting the strongest as well as the weakest colonies, because it is one of those malignant and contagious diseases due to the presence of a germ called by the scientists bacillus alvei. Adult bees are supposed to be beyond the reach of this germ, and the disease is therefore confined to larvæ between the ages of one and ten days. Just how this young larva becomes affected is not definitely known. It may be through contagion from the diseased comb or brood which contagion is brought to the young larvæ by the nurse bees, but in all probability the germ is introduced with the food. It has been said that foul bood develops from chilled or starved brood. This has been proven beyond a doubt not to be true. Since it is a germ disease it cannot develop when the germ which causes it is not present. On the other hand, the disease is so highly infectious that one drop of infected honey may ruin a whole apiary.

SYMPTOMS.

The first apparent evidence of the presence of the disease manifests itself in the behavior of the bees which do not seem to possess their usual activity but have a lazy, indolent manner.. There is apt to be some litter in the entrance of the hive as though the bees were loath to "clean house." A few bees may fan at the entrance. After the disease is well advanced a foul smell resembling melting glue may be detected without removing the cover even, and at some little distance from the hive.

On removing the cover an examination of an infected colony reveals the following peculiarities: The brood is not compact, but scattered. The empty cells, those not containing brood, may contain a dry scale in the bottom. The cappings over the dead larvæ are depressed slightly and darker than the healthy ones. There is often a hole in the center of the cap. Many larvæ, however, die before the cell is sealed.

If the examination is made when the disease is just beginning, the affected larvæ are no longer curled up, but either lie extended in the cell or are moving about unnaturally. As the disease progresses they lose their plump appearance, become flabby and finally die.

As decomposition begins the larvæ at first take on a yellowish appearance, and later turn brown. If a toothpick is inserted into the dead larvæ at this time and later and is slowly drawn out it will show a long, ropy tenacious string, which upon breaking, when drawn out to its fullest extent, flies back into the cell. This ropy, putrid mass slowly dries down and adheres to the bottom of the cell, forming a small scale. The bees seem reluctant to remove these dead larvæ, instead of hastening their removal as they do in other instances when larvæ die. Or it may be that the dead larvæ adhere so firmly to the cell that it is impossible for the bees to remove them. Whatever the cause may be, when the larvæ are killed by this disease they are not removed.

As a result of the disease the colony becomes weakened since the brood fails to hatch, and soon dwindles down to such an extent that it is utterly defenseless and is then liable to be robbed. As soon as the robbing begins the disease is transferred to other colonies, and unless the bee-keeper is watchful the whole apiary becomes infected.

It has been said "a bee-keeper who does not discover foul brood before his nostrils remind him that something is wrong is no man to treat the disease." It would be more proper to say that a bee-keeper who does not discover that something is wrong before his nostrils tell him of the presence of foul brood is no man to treat the disease, for foul brood is often found in the apairy of an owner who was not acquainted with it, but who after having been instructed as to its nature and treatment has effected a complete cure. Dr. Howard says, "I regard the use of any and all drugs in the treatment of foul brood as a useless waste of time and material, wholly ineffectual, inviting ruin and total loss of bees. Any method which has not for its object the entire removal of all infectious material beyond the reach of bees and brood will prove detrimental and destructive and surely encourages the recurrence of the disease."

The one method that has given the most universal satisfaction is recommended by Canada's inspector of apiaries, William McEvoy. His method is given below in his own words:

MC EVOY TREATMENT.

"In the honey season, when the bees are gathering freely, remove the combs in the evening, and shake the bees into their own hives; give them frames with comb foundation starters and let them build comb for four days. The bees will make the starters into comb during the four days and store the diseased honey in them, which they took with them from the old comb. Then in the evening of the fourth day take out the new combs and give them comb foundations to work out, and then the cure will be complete. By this method of treatment all the diseased honey is removed from the bees before the full sheets of foundation are worked out. All the old foul brood combs must be burned or made into wax after they are removed from the hives, and all the new combs made out of the starters during the four days must be burned or made into wax, on account of the diseased honey that would be stored in them. All the curing or treating of diseased colonies should be done in the evening, so as not to have any robbing done or cause any of the bees from the diseased colonies to mix and go with bees of sound colonies. By doing all the work in the evening it gives the bees a chance to settle down nicely before morning and then there is no confusion or trouble. This same method of curing colonies of foul brood can be carried on at any time from May to October, when the bees are not getting any honey by feeding plenty of sugar syrup in the evenings to take the place of honey flow. It will start the bees robbing and spread the disease to work with foul brood colonies in warm days when the bees are not gathering honey, and for that reason all work must be done in the evenings, when no bees are flying. When the diseased colonies are weak in bees, put the bees of two, three or four colonies together, so as to get a good sized swarm to start the cure with, as it does not pay to spend time fussing with little weak colonies.

"When the bees are not gathering honey, any apiary can be cured of foul brood by removing the diseased combs in the evening, and giving the bees frames with comb foundation starters on. Then also in the evening feed the bees plenty of sugar syrup, and they will draw out the foundation and store the diseased honey which they took with them from the old combs; in the fourth evening remove the new combs made out of the starters and give the bees full sheets of comb foundation and feed plenty of sugar syrup each evening until every colony is in first-class order. Make the syrup out of granulated sugar and put one pound of water to every two pounds of sugar and then bring it to a boil. As previously stated, all the old combs must be burned or made into wax when removed from the hive, and so must all the new combs made during the four days. No colony is cured of foul brood by the use of any drug. All the old combs must be removed from every diseased colony and the hive got away from the bees before the brood rearing is commenced in the new clean combs."

N. E. France, inspector of apiaries of Wisconsin, says, "All the difference from the McEvoy treatment that I practice, I dig a deep pit on level ground near diseased apiary, and after getting a fire in the pit, such diseased combs, frames, etc., as are to be burned, are burned in this pit in the evening and the fresh earth from the pit returned to cover all from sight. If diseased combs with honey in are burned on surface of soil there is great danger the melted honey will run on the soil and in the morning the robber bees will be busy taking home the diseased honey.

"Also I cage the queen while bees are on the six or eight strips of comb foundation, to prevent any swarming or deserting."

The equipment necessary for the McEvoy treatment is a large canvas or sheet, a broad pail partly filled with the corrosive sublimate solution, a sponge or rag, a bee brush similar to a Cogshall, a screw driver, or some other tool for prying the frame loose, and a set of frames containing only starters of foundation. The only time of day suited to the treatment is toward evening, when the bees have ceased flying to and from the fields. A bright moonlight night answers the purpose if many colonies are to be treated, though the bees are perhaps more easily handled just at dusk than in the moonlight. At this time we have little to fear from robbers or from infected bees flying to healthy colonies.

The method of procedure is about as follows:

Spread the canvas over the old stand, place the hive on the canvas. Gently shake the bees off the old combs into the hive, and brush all the bees of the old combs into the hive body. Remove the hive from the canvas, which should be gathered up by the corners in order to allow the bees to be shaken from it into the hive; then add the frames of foundation starters. Be sure that every bee is secured and placed in the hive for a single escaping bee might fly to a neighboring hive and infect the colony.

During the whole operation care must be exercised to prevent robbing. Before the work is done, all scattering drops of honey must be removed by washing with the corrosive sublimate and all bits of comb must be picked up. Never let one drop of honey get away to infect other colonies.

When you have a set of combs partly full of honey, it seems a sin to destroy them but unless you have upwards of ten colonies to treat, it will not pay to try to save an ounce of honey or wax. If you are a careful person you may make the combs into wax, and the honey may be saved by adding a little water and keeping it at the boiling point for two hours.

The old hive bodies may be scraped, the scrapings burned, and the inside painted with kerosene and set on fire. When it gets to burning well, throw in about two tablespoonfuls of water and clap on the cover. The water will be turned to steam and this will scald the inside of the hive.

If this operation be performed with sufficient care, the colony will be free from the disease, but it will require close attention and the best of care because of the tender condition in which the bees will be after the severe treatment, and the discouragement following the loss of all their brood. This treatment may be used at any time during the summer but preferably when honey is coming in, as the danger from robbing is then at a minimum.

There are doubtless many instances where a mild case of foul brood is taken for chilled brood, and it is possible that a case of foul brood may appear in a mild form early in the spring and then disappear as the summer opens, only to reappear later in the season. It is possible that this state of things is due to the fact that the honey in the cells is infected with the germs, and when the spring honey begins to come in freely, it is used to feed the brood, which spring honey, being free from germs, is eaten by the brood with impunity until the combs become full of healthy brood and the dead larvæ nearly disappear.

Perhaps the most favorable condition for the spread of the disease occurs when it becomes present in the yard of the bee-keeper who does not examine his colonies frequently. A colony becomes weakened from the failure of the brood to mature and the keeper may not know that anything is wrong with the colony. Soon the honey flow stops and robbing commences. Weak colonies are attacked first and in this way honey from this weak, diseased colony is taken to nearly every hive in the yard and especially to the stronger ones with disastrous results.

The extractor is an important factor in spreading the disease. A case of extracted combs, taken from a diseased colony, and after extraction put back into half a dozen different hives, may bring infection to each one of them.

In the winter of 1898-9 the bees were wintered in a cellar at the station. They were tiered up in the cellar in alternate rows with the bottoms of the hives removed. A diseased colony was placed among the healthy ones and marked. During the winter the bees did not remain quiet but ran out from the hives to quite an extent. In the spring the four hives, which had wintered in direct contact with the diseased one, were also diseased.

This shows that wintering the colonies in cellars with the bottom boards of the hives removed, may also assist in spreading the disease.

Another way in which the apiary may become infected is by the carelessness of the owner. Combs, partly filled with honey or brood are left lying on the top of the hive "for the bees to clean up." The waste from the wax extractor is thrown out where the bees can have access to it. A hive in which the colony has died is not at once taken out of the reach of the bees, but allowed to stand in the yard and the entrance of the bees not fully prevented. This is wrong. Even if there were no danger from disease, the hive should be closed as soon as the colony is dead, and the refuse from the wax extractor burned, never leaving it where the bees can get at it. Such carelessness encourages robbing and is an important factor in the spread of the disease. The extractor need not be discarded nor the practice of cellar wintering, but every bee-keeper should make himself acquainted with the disease, keep a vigilant watch, and stamp it out as soon as it appears. To leave one diseased colony in an apiary may mean the total ruin of all the other colonies. Even one drop of infected honey, if left where the bees have access to it, may mean the infection of the whole apiary. The owner must then take extreme precautions to prevent the entrance of the disease. He must even go to the trouble of rendering his hands, and whatever tools he uses, antiseptic by washing them in a three per cent solution of carbolic acid, which would be about four teaspoonfuls to a gallon of water. Or a solution of corrosive sublimate, using one-eighth ounce of the drug to one gallon of water. Right here it should be remembered that corrosive sublimate is a deadly poison, and one that must be handled with great caution. A very small amount spilled on the honey or comb intended for use will convert it into a violent poison. The disease may be transmitted to a healthy stock simply by the operator handling the frames of the healthy one after he has been examining a diseased colony. It is impossible to be too careful. For the man who does not wish to take the above precautions, the best method of procedure for him to rid his apiary of the disease is to burn all infected colonies and apparatus.

The following is the Michigan statute, which was passed at the 1901 session of the legislature. It provides for an inspector for the suppression of the disease in Michigan.

We are indebted for much of the subject matter of this bulletin to N. E. France, Inspector of Apiaries of Wisconsin, William McEvoy, Inspector of Apiaries of Canada, and to Prof. F. C. Harrison, of Guelph.

The People of the State of Michigan enact:

Section 1. The Dairy and Food Commissioner upon receipt of a certified copy of the record of the Michigan State Bee-keepers' Association, by the secretary of said association, showing that a majority of the members of said association recommended the appointment of an inspector of apiaries, shall appoint a State Inspector of Apiaries. Said inspector shall be responsible to the Dairy and Food Commissioner and shall comply with such rules and regulations as the Dairy and Food Commissioner shall from time to time prescribe for the carrying out of the work of said State inspector.

Sec. 2. The Dairy and Food Commissioner shall, when notified in writing by the owner of an apiary or by three disinterested taxpayers in the vicinity of the apiary, cause the inspector to examine such apiaries as are reported and all others in the same locality not reported, and ascertain whether or not the disease known as foul brood or other contagious disease exists in such apiaries, and if satisfied of the existence of foul brood, he shall give the owner or care-taker of the diseased apiaries full instructions how to treat said case as in the inspector's judgment seems best.

Sec. 3. The inspector who shall be the sole judge may visit all diseased apiaries a second time and if need be burn all colonies of bees and combs that may be found not cured of foul brood or other contagious diseases.

Sec. 4. If the owner of a diseased apiary, honey or appliances shall knowingly or wilfully sell, barter, or give away any bees, honey or appliances, or expose other bees to the danger of said disease or refuse to allow said inspector to inspect such apiary, honey or appliances, said owners shall on conviction before a justice of the peace, be liable to a fine of not less than fifty dollars nor more than one hundred dollars, or not less than one month's imprisonment in the county jail, nor more than two months' imprisonment.

Sec. 5. In addition to such individual reports as are required under this act by the Inspector of Apiaries, he shall make an annual report to the Dairy and Food Commissioner, giving the number of the apiaries visited, the number of diseased apiaries found, the number of colonies treated, also the number of colonies destroyed by fire, and an itemized account of his transportation expenses with affidavit annexed thereto.

Sec. 6. There is hereby appropriated out of any moneys in the State treasury not otherwise appropriated a sum not exceeding five hundred dollars per year for the suppression of foul brood among bees in Michigan. The inspector shall receive three dollars per day and actual transportation expenses for actual time served, which sum shall not exceed the money hereby appropriated, to be paid by the State Treasurer upon warrants drawn by the Auditor General and approved by the Dairy and Food Commissioner.

Sec. 7. Act number one hundred forty-one of the Public Acts of eighteen hundred eighty-one, being sections fifty-six hundred sixty-three, fifty-six hundred sixty-four, fifty-six hundred sixty-five, fifty-six hundred sixty-six, fifty-six hundred sixty-seven, fifty-six hundred sixty-eight, fifty-six hundred sixty-nine and fifty-six hundred seventy of the Compiled Laws of eighteen hundred ninety-seven, is hereby repealed.

This act is ordered to take immediate effect.

J. M. RANKIN, Apiarist.
C. D. SMITH, Director.

Agricultural College, Mich., June 4, 1901.

FORTY-FIRST ANNUAL COMMENCEMENT

MICHIGAN AGRICULTURAL COLLEGE, JUNE 16-21, 1901.

EXERCISES OF THE WEEK.

SUNDAY, JUNE 16.

3:30 p. m. Baccalaureate Sermon by the Rev. David R. Breed, D. D., Allegheny, Pa.,
Subject, "A Working Theory."

WEDNESDAY, JUNE 19.

2:00 p. m. Inspection of Battalion.
8:00 p. m. Society Reunions.

THURSDAY, JUNE 20.

Class Day at Grand Ledge.
8:00 p. m. President's Reception.

FRIDAY, JUNE 21.

Commencement Day.

10:00 a. m. Address, Prof. J. B. Johnson, C. E., University of Wisconsin,
Subject, "The Personal and National Benefits of Education in Applied Science."

COMMENCEMENT EXERCISES.

The forty-eighth annual commencement exercises of the Michigan Agricultural College occurred in the Armory, Friday morning, June 21, 1901, at 10 o'clock. The candidates for degrees, headed by President Snyder, the commencement orator, and the faculty, marched in and took seats on the platform, while Miss Hannah Bach played an appropriate selection on the piano. The Rev. George Humphrey, of Adrian, father of a member of the class, pronounced the invocation. The following program was then rendered:

Piano trio, "Imps and Sprites at Work," *Holst*, Misses Smith, Armstrong, Wright.

Oration, "Power," W. W. Wells, mechanical course.

Oration, "Technical Science in its Relation to the Home," Miss Fleta Paddock, women's course.

Oration, "Justin Smith Morrill," N. A. McCune, agricultural course.

Vocal solo, (a) "A Lesson from the Violets," *Marks*; (b) "In Springtime," *Fesca*, Miss Hadley.

Address, "The Personal and National Benefits of Education in Applied Science," Prof. J. B. Johnson, C. E., University of Wisconsin.

Degrees were then conferred as follows:

BACHELOR OF SCIENCE.

J. Guy Aldrich,
Franklin A. Bach,
William J. Bailey,
Hugh P. Baker,
Roy L. Brown,
George E. Chadsey,
John F. Coats,
Arthur J. Cook,
Harry J. Eustace,
Alice M. Gunn,
Gustave Gutekunst,
Celia A. Harrison,
Arthur H. Hayes,
George C. Humphrey,
Mark L. Ireland,
Don B. Jewell,
Charles W. Kaylor,
Samuel J. Kennedy,
Mary S. Knaggs,
Ralph M. Lickly,
L. Bayard Littell,
Charles A. McCue,
Newell A. McCune,
Robert S. Northrop,
Roy M. Norton,
Fleta Paddock,
Fred L. Radford,
Charles P. Reed,
George Severance,
Vernon M. Shoesmith,
J. Hackley Skinner,
John B. Stewart,
Horace T. Thomas,
Gordon E. Tower,
Walter W. Wells,
George D. White,
Roswell A. Whitney,
Vesta Woodbury.

MASTER OF SCIENCE.

William T. Shaw,
Dick J. Crosby.

COMMENCEMENT ADDRESS JUNE 21, 1901.

PROFESSOR J. B. JOHNSON.

THE PERSONAL AND NATIONAL BENEFITS OF EDUCATION IN APPLIED SCIENCE.

[Abstract of address.]

INTRODUCTION.

The beginning of the twentieth century marks the most significant era in the world's history. Westward the star of empire has coursed its triumphal way until West and East have come together in a life and death struggle the end of which cannot be foretold. Wholesale corporate production, also, has swallowed up nearly all individual capital and enterprise, and has captured the world's markets, by the greater perfection and the diminished cost of the products.

In South Africa the attempt of a medieval Christian people to shut out from their beclouded land the wave of nineteenth century progress has proved as futile as it was foolish. Progress is in the air, and as the air, it engulfs the globe. Nature does not more abhor a vacuum than she does permanence of form. What ceases to change and grow ceases to live. Even the rocks of the eternal hills are changed to clay and are dissolved in the surrounding seas. To attempt to scotch the wheels of progress, therefore, is but to invite destruction. One must "accept the universe" as it is and make the best of it. And our social world is changing with such marvelous speed it is almost bewildering to the most progressive races. It is with the greatest difficulty that these can keep the pace, while the less progressive nations are being left absolutely behind. A little slowing up of one people, therefore, is now equivalent to losing the race. We think we are driven to death already, but the gait is ever speedier, and if our lives become shorter in years they will be ever longer in accomplishment. If we can but find pleasure in our work, then the greater the work the greater the happiness. And why should we not find pleasure in our work? Never before were so many interesting problems opening up for solution. The most stimulating and soul-satisfying experience in the world lie in the over-coming of difficulties and in the solution of new problems. And these problems come trooping upon us. They are of all kinds—material, political, commercial, social. When in the past has the politics of every country been whole-world politics as it is today? It is no longer an American question, or a European question, or the Eastern question—it is a world question with which statesmen of all countries are having to deal. In business, also, the field of operations is no longer the town, or city, or state, or nation; it is the whole inhabited globe. And socially our problems are no longer purely domestic; they include the whole human race. Such questions as the relation between labor and capital; the relative rights and duties of the sexes; the control of business corporations; the rights of property and of inheritance; the inherent rights of man; whether the people shall support the state, or the state the people; the resort to arbitration in place of war, both between nations and between smaller aggrégates of men; the right of a more progressive nation to control and direct the destinies of a less progressive one; these and many more such questions are not peculiar to any one country, but are world questions of almost equal interest in all countries. The number of such problems now crying for solution in the political, in the commercial, and in the social field is almost legion. And are we preparing to meet and to successfully solve them?

It is well to remember that wisdom is not a matter of destiny. Neither is it a matter of inheritance. "It cannot be gotten for gold, neither shall silver be weighed for the price thereof." Let us therefore contemplate for a moment some of the essential elements of strength on which this nation must rely in the frantic race she has now set for herself and henceforth will be forced to run.

INTELLECTUAL ACHIEVEMENT.

First, I will place intellectual achievement. By intellectual achievement I do not mean a mere trafficking in other men's intellectual wares. I mean intellectual production. We need men and women who can be trusted to think for themselves on these great questions. Clear sight must precede wise action. We must realize the divine significance of a fact, and hence must be able to recognize a fact when we see it. We must be tremendous doubters. Most things which pass current for truth are the flimsiest falsehoods. We believe what we wish to believe, or what we are too indolent to question. We should train ourselves to scientific thinking and reasoning. The scientific methods of investigation should be applied to all questions alike. This can only be done by those schooled in the use of such an instrument. Modern education should be at least three-quarters scientific. To "see straight and to think clear" on all questions is not a natural gift. It must be cultivated. Few people know what science is, and fewer still are schooled in its methods.

Most persons seem to think that a science may consist of organized or systematized anything. Thus astrology, alchemy, palmistry, phrenology, were all in turn regarded as sciences, but are so regarded no longer. These all consisted in organized or systematized coincidences, assumptions, and theories, and we are not wanting in many modern systems of belief, quite as fanciful and groundless as these, but which are parading in the garments and adopting the terminology of science. That cannot be knowledge which is not true. Science includes, therefore, only what is known to be true. This suggests Pilate's query, "What is Truth?" I admit that in nearly all human affairs so called truth consists in the highest attainable probability. When one thing is to us more probable than any other alternative we can think of, most persons would say I believe this to be true. This may serve very well on which to base an opinion, if we must indulge ourselves in such luxuries, but it hardly answers the demands of science.

Again we must distinguish between qualitative and quantitative truth, or science. To say that all matter is mutually attractive is to state a truth, and a scientific truth, but it is a truth we could do nothing with. It is qualitative only. But to say that all bodies attract each other with a force which varies directly as their masses and inversely as the squares of the distance between their centers of gravity, is to state a quantitative truth which can be used as a tool of investigation and analysis. This is the law of gravity which Newton discovered.

On the other hand, scientists are constantly challenged by their literary friends to explain the essence of things as well as the laws in accordance with which the essence manifests itself. Thus, they say what is this force of gravity you talk so learnedly about? What is light, and heat, and electricity? What is the medium known as the impalpable ether which pervades all space and which transmits this light and heat without absorbing it? What is the mysterious life principle which causes every plant and animal form to produce its kind with such marvelous exactness, times without number? And, finally, what is the mind itself and where does it reside? From whence came it and where is it to go? These and an unending series of like questions we cannot answer, but must we hence admit that there is no science of these things? By no means. While we freely admit our ignorance as to the essence, we boldly proclaim our knowledge of many of the laws of being and of the manifestation of these secret substantial and spiritual forces. And this is quite enough to know, for most practical purposes. So rapidly as the knowledge of a subject can be generalized into laws, therefore, it becomes scientific, even though there remain whole realms of unknown and undiscovered truth still enshrouding the same subject matter.

This new knowledge is now coming to us with marvelous rapidity and from sources which increase in number in a geometrical ratio. This scientific knowledge has been turned also to such practical account in a thousand ways, and miraculous marvels follow each other in such rapid succession, that the average man finds himself dazed and his reason almost dethroned by daily observing the accomplishment of what but yesterday he had thought impossible. He is like Alice in Wonderland, quite ready to believe any improbable thing, if it only wear the garments of science. In this way only can we account for the extreme credulity, not to say gullibility, of this the greatest scientific age the world has known. To the average citizen all things are possible, and they only await the coming of the scientific magician to discover the trick by which the thing may be done. The very language used in describing the latest fake, if it be only an unknown tongue, will be accepted and adopted as properly accompanying the hitherto unknown forces of laws. In fact the greater the fraud, and the more mystifying the language, the easier it is to deceive the wary capitalist. From these facts we should conclude that the greater the possibilities of a given agency, the greater the necessity to determine its limitations.

While it is well to know something of the best that has been thought and said in the past, we must beware of limiting ourselves to this pleasing sipping of the stored honey of all past ages. It induces mental dyspepsia. This is the education of the Chinese. He studies only the sayings of his ancestors. His face is always backward, and hence he never goes forward. If the acquisition of a knowledge of the best that has been thought and said by our ancestors is wisdom, then the educated Chinaman should be the wisest of men. The western world starved over a thousand years on this sort of scholasticism. Europe had nothing else throughout the middle ages, and nothing came from it but stagnation. New truth and ever more new truth is the only nourishing food on which a people can grow. And this is intellectual achievement, and it lies at the very basis of all progress, and hence of all national prosperity. And as scientific education trains one in the perception and use of facts, and in the ability to separate the true from the false, so we can plainly see today that national progress is directly measured by the prevalence of scientific training in education. The three nations in which science enters largely into the school training of all children are Germany, America and Switzerland. In France the popular educational methods are shaped only to the passing of certain state examinations, and so have largely lost their vitality. In England the masses are practically uneducated, and in such schools as they have science finds little or no place. The notorious inability of the English generals in the present war to realize a situation not cognizable by their sense of sight, is but one of the thousand illustrations of the almost entire absence of the faculty of the imagination in the English mind. This ability to perceive the invisible is a distinctive product of a scientific education. Both England and France are relatively dropping behind other nations, and in the opinion of many this can be traced to their methods of education, while Germany, America, and Switzerland are all forging to the front. This is because these countries contain so many citizens who have learned what to do and how to do it. There are, however, many ways of acquiring an education in the realities of the world, besides going to school. The American pioneer has probably acquired this knowledge of things as they are, and has learned what to do and how to do it more effectually than any other class of men in the work. He has also learned self-reliance and has developed a tremendous amount of private initiative. He stops at no task, however impossible it may seem to others. He has achieved a continent and created a nation. As compared to a mere man of books, he is a giant in all matters which give strength to a nation. I cannot stop here to insist on the absolute necessity which rests upon every man and woman who aspires to serve as a significant factor in society, in any capacity, to cultivate at all times and on all proper occasions, a clear and forcible style of expression in conversation, in formal address, and in written composition.

MORAL UPRIGHTNESS.

I have placed clearness of mental vision before moral uprightness not because it is more important, but because it is more fundamental. The mind must perceive the right before the conscience can enforce it. This field of moral education and training belongs to the teacher and minister alike. As a teacher I am convinced that the education of children and young people should be largely occupied with the eternal verities. And this again means a training in the exact and natural sciences. A hypocritical scientist it is impossible to even conceive. How can a sophist or a hypocrit be a searcher after truth? This passion for the true, whatever it may be, and regardless of preconceived opinions, is the peculiar and dominating characteristic of all scientific investigators. What more wholesome moral atmosphere in which to raise a child? The boy who has acquired a passion for any line of scientific study can safely be trusted to follow his bent. He will come to no harm and is likely to come to something great and good.

As many of the traditions of religion fail and fall, the eternal truths of science will take their place, and we shall build on this sure foundation a new religion and a more rational and just morality which will be to nations a bond of union instead of a perpetual flame of discord and disruption, as religion has been in the past.

MATERIAL PRODUCTIVENESS.

Following intellectual achievement and moral uprightness, I will place material productiveness which results from our modern scientific achievements. Here on the threshold of the world's workshops, we are struck at once with the magical transformations which have been effected in the methods of production. The skillful mechanic, who with great manual dexterity, and with a complete knowledge of his art, fashioned a product from the raw material to the finished state, is no more. His like is no longer found outside of Asia; these workers who entirely made up the guilds of former centuries, and who were the pride and glory of Europe in the renaissance, were first reduced to the performance of single manual operations, the complete product being then the work of many hands, and finally, with the introduction of the automatic and labor-saving machinery of today, they have become mere overseers and tenders of such machinery. As we walk through any great modern factory, therefore, we see not manual workers, but machine attendants. But let us not make the very common mistake of supposing that these men and women, or boys and girls, are mere automatons, or animated attachments to the machines they operate. This is the mistake our literary and clerical friends nearly always make. They deplore the age of steam, wind, water, and electricity, and of labor-saving and automatic machinery, and sigh for the good old days when the blacksmith was the only worker in iron; when the wheelwright and the cabinetmaker did all the work in wood; when the shoemaker and the saddler were the workers in leather, and when their grandmothers had added to their other labors the spinning, weaving, and making up, by hand, of all the family wardrobe. These workmen, by laboring from twelve to sixteen hours a day, at small wages, managed to earn only enough to provide the bare necessities of life. But the steam engine and multiple production has now changed all this. Not only has the slavish muscular toil been graciously lifted from off our industrial workers, but the wearing and anxious care formerly placed upon all such workers in order that they might bring their work up to the requisite standard of exactness, has also been taken over by mechanisms which not only never tire but which will turn out a million pieces exactly alike. The attendant upon such a mechanism, charged only with keeping it in order and well supplied with the raw material, has time and opportunities, yes, and the necessary stimulus, to engage in profitable study and invention. The very complexity and the marvelous ingenuity displayed in the machine itself is a perpetual challenge to the operator to comprehend its construction and to improve its accuracy or its output. In place of a more or less degrading physical toil we now have for these workers a most wholesome combination of physical and mental exercise which is peculiarly conducive to mental self improvement both in the workshops and also when the day's labor is over. The shop conditions were in fact never so favorable to mental effort out of hours as they are today, and the industrial worker was never before so well provided with self-helps.

SCIENTIFIC EDUCATION THE BASIS OF MATERIAL PROSPERITY.

But you ask how has this wonderful industrial revolution been wrought? How comes it that the nineteenth century marks a far greater industrial progress than all the untold previous centuries combined? By what newly discovered species of magic has the world been so tranformed that our revolutionary fathers would not recognize the planet if they were allowed to revisit it, but would insist they had been transported to some other celestial sphere? There can be but one answer to these questions. The industrial revolution is but one of the many fruits of the scientific progress of the century. The sciences here involved, also, are those relating to inanimate matter. Mathematics, physics, chemistry, mechanics, geology, mineralogy, metallurgy, these in their multitudinous ramifications have, in their applications to the arts, transformed the world. While chance or accident, or a blind empiricism has often led to important discoveries and inventions. the successful development of industries based on these is always a matter of the scientific application of means to ends. As a rule, however, the scientific laws and principles have resulted from long and patient scientific research, on the part of our pure scientists, and the utilization of these industrially has been gradually developed by a class of men whose peculiar business it is to bring the materials and forces of nature into the service of man. These men are known as civil, mechanical, electrical, mining and chemical engineers. The discoveries of our pure scientists, followed up by the inventions of mechanics and engineers have together wrought these wonderful marvels. And as the prevalence of science teaching has brought a progress of science which is ever at a swifter pace, so the now widespread technical instruction in this country is bringing our industrial progress along by leaps and bounds. But the greatest economy of production in any line is only attainable by the most scientific methods. The prevention of wastes, the utilization of by-products, the saving of labor, the increase of the output, the perfection of workmanship, the purity of the product, all these are scientific and engineering questions which find their most successful solution in that country in which are to be found the greatest number of pure and applied scientists. Scientific and technical education is today the foundation of all material prosperity.

THE APPLIED SCIENTIST.

And now a word as to the type of man who is our main reliance in this industrial evolution. It is not so much the pure as it is the applied scientist. The discoveries of the pure scientist are common property the world over. We can avail ourselves of a scientific law discovered in Germany as well as though it had been announced from Harvard, or Columbia, or Johns Hopkins. But to utilize these laws and discoveries in actual industries requires an applied scientist to be on the ground. It is the engineer, or applied scientist, therefore, to whom we must turn in the progress of our industries, and hence we will now consider what qualities and accomplishments he must possess, in contradistinction from the pure scientist, in order to fully meet the requirements of the position.

To the applied scientist that only is food, or is prized, which can be shown to be capable of serving useful ends. It is his business to select from the pure scientist's store of universal truth such as he can use for particular purposes.

Our applied scientist must have free and intelligent access to the great storehouse of established truth. He must not only follow the progress of science in one field, but in every field in which he undertakes to practice; he must therefore be a constant student. Our applied scientist must know also how to do things. This is the knowledge the mechanic has. In learning his trade he has learned the fruits of the world's experience in doing things.

Again he must know what needs to be done. To know this he must be a man of affairs. He must be acquainted with the ways of commerce and trade, both at home and abroad. He must foresee the needs of the immediate future. He must know the difficulties and hindrances of present methods before he can provide remedies. He must also be an economist. He must know the cost of things and the wastefulness of present methods before he can determine whether or not it is worth his while to invent new ones. In fact he must know as much as possible about how the world now does its work if he is to facilitate matters. This kind of knowledge also the pure scientist does not possess.

But what else must our applied scientist have and be? He must have largely developed in him *sine qua non* in the profitable solution of all new problems,—invention. This seems to be one of nature's gifts. It can be cultivated, however. It is this faculty which suggests the various possible ways of accomplishing a given thing. From this knowledge of affairs our applied scientist sees what needs to be done. His invention suggests a hundred ways to do it. It unconsciously runs to and fro throughout his mental storehouse of acquired facts, both of science and method, and brings to his attention all the possible ways of accomplishing the results.

Thus we see our applied scientist is at once a student of science, a mechanic, man of affairs, and an inventor combined in one. Nothing short of this will fill the bill. Being a scientist only, he knows not what to do or how to do it. Being a mechanic only, he knows particular ways of doing a given series of things, and he is sure to give you of his little store, whether it serves the purpose or not. Being an executive man he sees what ought to be remedied, but he knows not what to put in its place or how to accomplish any desired end. He probably gets a "practical man" to come and do something but the chances are very much against this something being the best thing, or the thing which should have been done. Being an inventor, without the knowledge of either the scientist or the business man, is indeed a misfortune.

To fit a man for this high calling our technical schools are established. They put a young man in the way of becoming what we have here described. He there learns the elements of a series of sciences and their applications which it is absolutely necessary for him to know. If he precedes or accompanies this training with a considerable amount of laboratory and shop practice, such as is now given in all our leading technical schools, and if he also spends his vacation at such work, he learns something of the practical applications of scientific knowledge and the mechanic's art. Supplementing this with a knowledge of the business world and of men, cultivating a pleasing address, but schooling himself to the strictist honesty of motive and act, both with himself and towards others, he becomes favorably known. If in addition to these he remains a constant student, and possesses a sufficient amount of invention, he should ultimately become the Applied Scientist par excellence; such a man could safely be consulted in the solution of new problems, and this is the special field of the applied scientist.

THE ACHIEVEMENTS OF PURE AND APPLIED SCIENCES.

When we ponder on these marvellous achievements of one short century, mostly by a crude empiricism in applying the discoveries of science, what may we not hope for from the endless future with an intelligent direction given to the labors of those who seek to garner the fruits of all science and not to know the law but to control its operation, to harness the very laws of nature to the car of human progress?

THE BLESSINGS OF MATERIAL WEALTH.

While material progress and prosperity are not the highest good, they bring the conditions which make the higher life possible. You cannot develop a man spiritually until he is supplied with the comforts of life and has leisure in which to cultivate the spiritual graces. Let us also not be afraid of too much material prosperity. We are learning the generous uses of wealth. Wealth is more and more being turned into channels of popular scientific and industrial education, and this education in turn leads legitimately to greater wealth and also to a greater interest in the high things of this life and to lessening interest in the selfish, and sensuous, and fashionable, and frivolous, and idle amusements of life. In fact, this education in the physical realities of life is the only form of education which will surely win the interest of the man of business and of affairs as against the counter attractions of money-making and money-spending. When the passion for yachting and horse racing has been supplanted by a passion for developing the resources of nature, and for discovering new truth and applying it to the ever increasing needs of modern society; when the love of personal display and the desire to excel one's neighbors in a vulgar show of wealth has been supplanted by a love of the true and beautiful in nature, which leads of necessity to a higher appreciation of the true and beautiful in life; when, in short, the lower, narrower, and more selfish interests of the wealthy class have been replaced by those higher and more altruistic interests which come only with a broader education along lines which appeal to their natures and their tastes, then and then only, will wealth become a fruitful means to righteous ends. In such hands there cannot be too much wealth. In that day it may be hoped there will be no idle rich, and that wealth will be used and not abused.

THE LIFE OF SERVICE.

The following was addressed directly to the graduating class:

Finally, to clearness of mental vision, to moral uprightness, and to material prosperity, we must add a spirit of self-education to such public and private service as we find ourselves able to perform. Verily, he that would save his life will lose it, and he that would lose his life in the larger life of his family, his community, his state, or his nation, will find it returning to him an hundred fold. Honesty is no more the best policy than is that of disinterested service. Even as a means of self-advancement there is no ladder by which one may climb so fast or so high, and certainly which is so absolutely safe and sure, as that of service to others. Society pays its debts, but it is slow to advance a loan. Make society your debtor, but without claim for reward, and every man and woman becomes your friend and well wisher. This service to society must be sincere and disinterested, however. We must lend our services, "hoping for nothing again." If our service is but a piece of shrewd speculation on our part, if we expect to return and claim our own with usury, it is hypocritical and is soon recognized as such. Such service is barren of benefit either to the server or to the served. A disinterested service, however, is always rewarded, though sometimes the debt has long to run. This is the kind of service on which the nation must rely. This alone is patriotism. We must support the government by every means in our power, without hope of reward. Not "What is there in it for me?" but "What is there in me for it?" should be our query. Without such citizens no nation can long survive.

Even in the matter of paid service one must always do more than his duty if he looks for rapid advancement. The rate of advancement is directly measured by the service rendered your employer over and above what you are paid for. The young man who is constantly balancing his wages against the labor performed fails of promotion and soon joins the ranks of the discontented.

And now you will all ever continue, I am sure, to be students as well as workers, and the greatest good fortune I can wish is that you may all lead lives of great service to your families, to your communities, to your state and to your nation, because therein only lies the road to happiness.

My thesis is, therefore, that we have fallen on critical times, and there is need of the clearest heads and of the stoutest hearts. The world is moving at a rapidly accelerated speed. A nation's life today is not assured by its rate of progress. Our past achievements have been more providential than personal. Our future as a nation will depend more on our wisdom, on our moral uprightness, on our scientific competency, and on our disinterested service than it has in the past. To this high service, therefore, are we called. With a clarified vision to distinguish the true from the false; with a singleness of purpose in seeking the true and the good; with a wide dissemination of a knowledge of what to do and how to do it; and with a self-dedication to the service of society and hence of the state, we may all become, in our several fields of labor, national benefactors.

TECHNICAL SCIENCE IN ITS RELATION TO THE HOME.

FLETA PADDOCK, COMMENCEMENT ADDRESS, REPRESENTING THE WOMEN'S COURSE.

During the youthful period of human development the knowledge obtained was through empiricism, the result of casual observation. Every science had its birth in empiricism, and this empiricism will continue to occupy a portion of scientific work as long as there is opportunity to acquire knowledge. It keeps alive the spirit of speculation, yet the number of demonstrated facts has become so great that speculation is kept in the background in the minds of scientists, and is used only as a stimulus to research.

The struggle of the sciences for their present position has been long and, in a sense, bitter, but evolved from the widely separated and imperfect theories of the past, there is in reach of the present seeker after truth, an abundance of classified knowledge.

In the home has been the same progression. The homemaker is no longer satisfied with the traditional methods of an empirical nature, but seeks to understand the principles involved in her sphere of activity, and to place her duties on a scientific basis. By assuming this attitude, she relegates tradition, empiricism and superstition to the rubbish garret, and endeavors to subject scientific laws and facts to her use. She thus makes a higher standard of learning for herself, magnifies her position to its true proportions, and rules over her province resourceful in thought and action and highly technical in its character.

Many educators have seen the necessity of a systematic course of training, which will prepare women to deal with the household problems brought about by this change in their relation to the home, and have, through their influence, introduced courses of study in the various schools to meet the demand in this work. From many sources knowledge is accumulating and it is of such a character as to be necessary to every woman who would make her home the laboratory in which her mental and physical life is developed. She surely should possess a scientific knowledge of the body and those factors which influence it in health and disease. When there is an attempt made to understand the significance of this, there becomes involved many scientific subjects of diverse complexions. It especially designates Physics, Anatomy, Physiology, Chemistry, Sanitation, Bacteriology and Dietetics. These, therefore, are fundamental to a comprehensive view of the duties found in the house. They are the substance of the art of living. Can anything be further from the truth than to mention this work as a fad? Truly, ignorance alone must be responsible for misnomers of this class. If based upon scientific research conducted as thoroughly and carefully as in problems of other sciences, this will not be a fad but a permanently established educational movement.

That a more perfect idea may be obtained concerning science in the home, specific treatment of some subjects may lend aid.

Home sanitation is vital in its consequences and therefore deserves careful attention from those who may be held responsible. The work carried on by Sanitary Associations, Boards of Health and people in authority has succeeded in arousing the interest of homekeepers respecting the hygienic condition of their homes. It is in the house and by the homekeeper that the work must be done. The man of the house comes and goes and his work is elsewhere. The home is the woman's domain and when danger threatens she is there to carry the burdens. In one way every woman should be a Florence Nightingale. She proved what foes light, pure air and good food are to disease, and so opened the eyes of the military authorities to the needs of the army that today the death rate of the English army is only one-tenth of what it then was. In demonstrating this she not only showed the effect of sanitation upon the army but upon the home where its importance cannot be overlooked.

Epidemics are no longer, as formerly, considered a punishment sent down from heaven. They are indeed a punishment but for the sin only of ignorance. Pasteur proved that the feasibility of arresting disease is no longer an ideal. Millions of people have been saved from death and poor health by the progress of science armed with the knowledge of tuberculosis, the cause which produces it, its nature, its development, the dissemination of the contagion and the means by which it may be held in check. The American home is no longer blindly submitting to the onsets of this foe but is successfully striving to leave no loopholes for an attack since the home is doubtless responsible for the progress of all contagious diseases.

Again we find a pertinent illustration in the scientific development of cooking. This branch is better established—not because it is more important than sanitation—but because it appeals more forcibly to the daily wants of man.

The homekeeper realizes the importance of having the proper kind of food well cooked and served. She should also know how food contributes to the body; how the food substances are changed on their journey along the alimentary tract; how they are acted upon by the digestive juices and assimilated by the body.

Some conception should be formed of how this food after entering the body is used in constructive work of one kind or another, and in what form eventually it is eliminated. Throughout all of these changes it becomes possible to follow and measure the elements entering into the constitution of the food so accurately that any departure from the normal conditions may at once be noted. A harmony exists which to destroy means to create a discord on functional activity or to produce disease. In the case of nitrogen it is possible to alter its offices in the body by associating with it varying amounts of other food material. In order to manipulate food substances to produce the different and desired effects upon the body, the homekeeper should have a technical knowledge of the subjects involved. Without such a knowledge she becomes helpless in the control of natural forces and operates only in an empirical manner. She is responsible for many things, and in order to accomplish the desired end she must have the information which technical science will give.

Further than this it becomes necessary to acquire a broader knowledge of the sciences, such as Chemistry, Physics, Anatomy, Physiology, Bacteriology and Botany than has been implied in the foregoing illustrations. This paper purposely omits the discussion of other phases than that of the sciences which we believe to be fundamental to the intelligent and harmonious development of the home.

In managing the home, therefore, the homemaker will find much need for thought and study, and will have no cause to complain of the monotony of it all. She will find no time for the agitation of questions which take her out of the feminine boundaries into the masculine fields of labor.

It has been noted in our casual review of this subject that the sciences underlying the home are working their way gradually to that position now occupied by the sciences upon which medicine and agriculture are founded, and, from our discussion of Sanitation and Cooking it will be easily seen how technical science affects the home.

The civilization of a people may be measured by the condition of its women, for with the advancement of our civilization has come the emancipation of our women and their exaltation in the home. The nation depends upon the home, and the home, in turn, depends upon the health and happiness of the people composing it, which cannot be secured unless the home is based upon scientific knowledge. Someone has said: "Scientific housekeeping is neither beneath the attention of the refined, nor beyond the reach of the uncultured. It is the duty of the rich; it is the salvation of the poor."

JUSTIN SMITH MORRILL.

N. A. McCUNE, COMMENCEMENT ADDRESS, REPRESENTING THE AGRICULTURAL COURSE.

The close of the revolutionary war and the opening of the nineteenth century wrought great changes in all industrial pursuits. The ties to the mother-country which had so long checked the nation's progress, were shaken forever, and new energy, new strength suddenly arose, and entered into every department of human enterprise. And of those pursuits whose advancement was most marked under the new regime, none showed greater changes, or indicated broader avenues for development than agriculture. The rapid acquisition of land to the West and South, with their diversity of climate, their wonderful alluvial soils, their teeming valleys, soon impressed the American farmer that his was a heritage of tremendous resources—his for the taking. Therefore many of the older homesteads were abandoned for the fields of the West, and the advancemnet of the one section was gained through the retrogression of the other.

Thus husbandry developed, constantly embracing new phases, and expanding beyond the bounds of co-operation and definite control. Other industries were likewise giving greater scope to agricultural science, and were steadily establishing methods which were new in agricultural practice. But with all this advancement, this stupendous expansion of the scope of agriculture, embracing yearly its thousands of acres of virgin soil and primeval wilderness, with the marvelously increasing annual yield, with every apparent avenue for development, there yet remained one factor absent. A plan, a scheme for the establishment of permanent institutions throughout the union, where agricultural science would be taught, and where investigations might be carried on in the interests of husbandry—this as yet was lacking.

Early in the century, a few attempts had been made toward agricultural education. Here and there agricultural and horticultural societies had been formed, local fairs held, and now and then a publication on agriculture had appeared from the pen of some patriarch of the plow. In one or two states, minor agricultural schools had been established by private enterprise, where the cruder branches were taught, and where for the first time, the chemist's mystic powers were harnessed in the interests of agricultural science. Science, indeed, had found its way into a few of the academies and colleges; manual training had received some attention. But such efforts were spasmodic. They were but the humble beginnings of a greater end.

It was well for the followers of agriculture, that, at this juncture, a man of acute perception should endeaver to crystallize this increasing demand for scientific learning into form and power; well for them that he should turn aside from the heat and fury of the hour, and find his energies needed in tardy labor and struggling industry. In a time when northern homes were giving their bravest and best to battle and sombre southern plains were ghastly with the blood and brains of men; while the industries of a nation lay paralyzed by the mighty conflict in war, it was well that one man should turn his back to ambulance and cannon and seek to better his countrymen through the arts of peace, rather than the ravages of war. That man was Justin Smith Morrill.

In the bill introduced into the national house, July, 1862, Mr. Morrill proposed a system which at last should minister to the needs of the industrial classes. It was a plan at once original, complex, far-reaching, consummate. In the words of the measure, it provides for "the endowment, support and maintenance of one college in each state where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanics arts, in such manner as the legislature of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." From the first fierce opposition assailed the bill on every hand. Eminent men everywhere condemned it as interfering with states' rights. Newspapers ridiculed it as a scheme utterly incapable of prosecution. Public sentiment laughed at the man who would teach the farmer's son to apply science to his craft. But the persistence of the modest New Englander would not down. Ceaselessly, patiently, he worked, till his task was done. True public servant, he had an inborn sympathy for all manual art, and continually sought to uplift the standard of the laborer. Profound statesman, he exercised that intuitive foresight which ignores present conditions, and foresees problems which the years still hide.

Thus was established a system for the dissemination of agricultural knowledge; a system whose benefits will never be known, and whose influence will extend to all coming generations; a system which is ever tending to create that better mode of husbandry, where science is correlated with practice, the virtues of the one being combined to enhance the virtues of the other. It is a system which has affected nearly every arable section in our country. It has mutualized the varied commercial interests of the farmer. It has transmuted the abstruse sciences into concrete knowledge pertaining to every branch and phase of husbandry. It has expelled the old and brought in the new, in method and theory, and the old empiric laws have been laid away on the shelves of time together with the crudities of ancient handicraft, or the doctrines of old-time astrology. By its diffusion of knowledge, it has brought happiness and abundance into thousands of homes, where dwell the brawn and sinew of our nation. And lastly, this system has established public institutions throughout our land, whose interests are the interests of applied science; institutions which number as we number our commonwealths, and whose power rests in the united support of millions. All honor to him by whom these institutions were founded. All honor to the name of Morrill! All honor to the agricultural colleges of America! All honor to the sincerity of their purpose and the loftiness of their ideals! May they ever add strength to strength as manual industry develops; and may their numbers increase as the nation extends her borders farther into distant lands.

The New England settler's home was a primitive one. It was a home bare of ease or luxury; a home whose threshold the stranger seldom crossed, in a region where the straitened ties of denser population had never curtailed the freedom of the savage; a lonely home, encompassed by an almost unbroken wilderness. This has been the home of many of America's patriots, this was the home of Justin Smith Morrill. It was a Christian home, and the simple Christian faith taught there, wrought the solid basis for the higher virtues of his later life. The frugality practiced, the persistence and sturdiness acquired by that frontier life, brought forth the fearless man of action, destined to long service for his country. And it cannot be doubted, that all those qualities of disposition and action which framed the career of Justin Morrill, found their origin in the hardy, rigorous life he followed from youth to manhood, and which were sustained by the spotless purity of his character.

Yet, there was nothing of grandeur or imposing greatness in the character of Justin Morrill; none of the enthralling magnetism of Blaine, none of the wonderful brilliancy of Hamilton. His was the type of modest worth, of quiet, constant devotion to duty. His path was the plain, straight path of public and private virtue. To popular favor, he was oblivious. There was not an element in his nature which betokened anything of self-aggrandizement or seduction to private interest, which have so blighted the careers of some of our greatest statesmen.

But it is vain to speak thus of Justin Morrill. In life, he needed no voice of praise, no robes of honor. And in death he needs no eulogists. He needs no memorial monuments. Forty-seven institutions of learning, the spires of their halls rising to meet the sun, their acres stretching forth to receive its light, constitute monuments to his memory of perpetual power, monuments whose influence will ever extend higher and higher in the estimation of men, till they will eventually wield an influence in every avenue of manual industry. And, throughout America, ten million men, who live by the plow, whether amidst the granite hewn hills of New Hampshire, in tropic glades of Florida, on limitless prairies of the West, or in barbarous archipelagoes beyond Pacific seas, will thank their God, that, in a period when agriculture had reached a critical mark, He should raise up a man with the keenness of vision to foresee the industrial problems of coming generations; that He should create a man to organize and perfect a system for the diffusion of agricultural knowledge and thereby to establish a basis which will insure forever the stability of America's agriculture, on whose welfare rests the fortune and prosperity of a mighty people. And, through the flight of years, as the posterity of those ten million husbandmen is increased, it may be, to thirty million, may not only they, but may a whole nation, among her many distinguished sons, ever honor and revere the name and memory of Morrill, the Father of Industrial Education in America.

POWER.

W. W. WELLS, COMMENCEMENT ORATION, REPRESENTING THE MECHANICAL COURSE.

We are continually pointing with pride to the achievements of our inventive genius as shown in our labor saving machinery, and indeed the man who causes one day's labor to produce twice as much of the comforts of life as it formerly did is no less a public benefactor than one who causes two blades of grass to grow where one grew before. But there is one field in which the inventor, the scientist, and the engineer have contributed much toward the material prosperity of the world and without which our labor saving machinery would be comparatively worthless. I refer to the harnessing of the forces of nature to do man's work. Imagine how our scale of living would have to come down if we had no power but our own muscles with which to provide for our wants.

Probably the first force, besides his own muscles, that man made use of was the muscular force of animals, and this is one of the most important of our prime movers to this day, in spite of engines and railways and automobiles. Then, as he acquired more skill in the making of machinery, he began to use the forces of wind and water. But wind cannot be depended upon, and water power cannot always be had where it is wanted, so these sources of power are limited in their application.

It is the heat engine that is doing the work of the world today. Not only the steam engine, the air engine, and the gas engine, but in fact our horses and our own bodies are heat engines and the most efficient heat engines we have, so far as the relation of the quantity of work done by a given amount of fuel is concerned. If hay and oats cost no more per ton than coal we might perhaps be running our factories by horse power.

A century ago the steam engine had just begun its work and the industrial progress of the century has been largely due to the development of the type of heat steam engine. It has been adapted to almost every kind of work, and its efficiency increased until now some of our best power plants use less than a pound and a quarter of coal per hour for each horse power.

But even now we are using only about fourteen per cent of the energy contained in the coal. This fact leads many to think that there is a wonderful chance yet for improving the efficiency of the steam engine, but our study of thermodynamics shows us that the efficiency of a heat engine is limited by the change of temperature of the working fluid, that an engine that would have an efficiency of one hundred per cent would have to convert all the heat of the working substance into work. which would mean that the steam or other working substance, would have to leave the engine at the temperature of 460 degrees below zero. If we could heat the steam to the temperature of red hot iron we could not expect to obtain more than forty per cent of the energy of the coal even with the steam exhausting into a condenser at a pressure of only one-fifth of one atmosphere. It is easy enough to convert other forms of energy into heat, but not so easy to convert heat into mechanical energy.

Many attempts have been made to produce a more efficient engine by using some other fluid instead of water but the laws of the conversion of heat energy into mechanical energy are independent of the special properties of any substance. Hot air engines have been used to some extent, but their efficiency is low largely on account of the difficulty in transmitting heat to and from the working substance. This difficulty is overcome in gas and oil engines by mixing the fuel with the air and thus generating the heat in the working substance itself. The gas engine can work through a greater range of temperatures and hence has a greater thermal efficiency than the steam engine, but it uses a fuel that is more expensive in most localities. It has its advantages and its disadvantages as compared with the steam engine. Largely on account of the small amount of attention required, it is used quite extensively for small powers, especially where the load is nearly constant and the service intermittent. It is also finding a new field of operations in utilizing the waste gases of blast furnaces, which are peculiarly adapted to this type of engine.

When the gas engine first made its appearance, again when the electric motor came into use, and still later when Tripler began to make liquid air by the barrelful, we were informed that the steam engine would soon be a thing of the past to be seen only in our museums, but it is still doing business and promises to stay with us for some time to come. Its only real rivals are the gas engine and the turbine. The gas engine is finding its own sphere of usefulness in those places for which it is best adapted but it will have to be greatly improved before it can take the place of the steam engine. The turbine with the aid of the electric motor has taken the place of the steam engine in some places within convenient distance from our waterfalls. But electricity, as used for power, is in no sense a prime mover but simply a means of transmitting power. Instead of competing with the steam engine electricity has furnished it with a new field of labor, and the requirements of this class of service have led to some marked improvements in the engine.

Liquid air is no more a prime mover than electricity, for we cannot produce it without absorbing power and the law of the conservation of energy holds here as well as elsewhere. It may become useful as a means of storing power however.

We have no reason to expect that any of our sources of power will go out of use, at least for a good many years yet. Horses, steam and gas engines, water wheels and electric motors all have their uses and their limitations. The mechanical disadvantages of the reciprocating engine have led many a man to spend much time and labor trying to devise a satisfactory rotary engine.

One of the problems of the twentieth century will be to find a source of energy adequate to meet the demands of what will be more than ever an age of power. Our supply of fuel is limited and we cannot expect our coal fields to supply us with power for many centuries more if the present rate of use and increase keeps up. Will men then learn to live without the aid of power, will they use coal more economically or will other forces be utilized? One improvement which seems quite possible is the more economical conversion of heat into other forms of energy. In the electric light we get about one-half of one per cent of the energy of the coal consumed. The man who will produce electricity from coal economically will be given a chief place among our inventors, and the man who can imitate the firefly and glowworm in producing light without heat will not be far behind.

Another field for the inventor is found in the storage of power. The storage battery is about the only means now available. It is used to some extent where the power available or required varies greatly, but it is too heavy to be shipped from place to place.

Liquid air contains nine times as much energy as can be packed into a storage battery of equal weight. It may possibly enable us to bottle up the energy of Niagara and ship it hundreds of miles to points far beyond the reach of electrical transmission.

But a pound of petroleum contains forty times as much energy as one pound of liquid air and it can be shipped and stored without loss. If we could manufacture a similar substance out of cheap materials we might be able to store up the energy of the winds and our water power and use it wherever and whenever we want it. We are already using a similar method of producing light. We light our bicycle lamps and some of our buildings with the energy of the St. Mary's river, through the medium of calcium carbide and acetylene gas.

There is a vast amount of water power yet to be utilized and, as coal becomes more expensive, factories may be driven to those localties where it can be obtained. The five million horse power at Niagara could run a monstrous manufacturing city and it would not be a smoky city either.

Another great source of power that is used but little is the direct heat of the sun. Solar motors have been experimented with to some extent but they can hardly be considered a commercial success as yet.

The solar motor may not be used very extensively for many years to come, but there are localities where steam power is prohibited on account of the cost of hauling the coal, and where the sun shines most of the time in which it should prove valuable. It may be the means of reclaiming many acres of desert land and thus make two blades of grass grow where nothing grew before.

Solar motors, wind mills, and water wheels utilize forces that promise to last as long as the sun shines, so we have not much reason to fear that the progress of the world will cease because of the exhaustion of what are now our chief sources of power.

MICHIGAN STATE AGRICULTURAL SOCIETY.

REPORT OF THE TRANSACTIONS OF THE SOCIETY FOR THE YEAR 1900, AND PROCEEDINGS OF THE WINTER MEETING, AND OTHER MEETINGS OF THE EXECUTIVE COMMITTEE PREVIOUS TO JUNE 30, 1900.

OFFICERS FOR 1900.

President—M. P. ANDERSON, Midland.
Vice-President—L. J. RINDGE, Grand Rapids.
Treasurer,—C. W. YOUNG, Paw Paw.
Secretary—I. H. BUTTERFIELD, Agricultural College.

EXECUTIVE COMMITTEE.

Term ending January, 1901.

Eugene Fifield	Bay City, Bay County.
L. W. Barnes	Byron, Shiawassee County.
W. P. Custard	Mendon, St. Joseph County.
William Ball	Hamburg, Livingston County.
W. E. Boyden	Delhi Mills, Washtenaw County.
Eugene Jones	Grand Rapids, Kent County.
J. E. Rice	Grand Rapids, Kent County.
C. A. Waldron	Tecumseh, Lenawee County.
John McKay	Romeo, Macomb County.
John A. Hoffman	Kalamazoo, Kalamazoo County.

Term ending January, 1902.

E. W. Hardy	Howell, Livingston County.
Frank Maynard	Jackson, Jackson County.
F. L. Reed	Olivet, Eaton County.
S. O. Bush	Battle Creek, Calhoun County.
H. R. Dewey	Grand Blanc, Genesee County.
R. D. Graham	Grand Rapids, Kent County.
John Lessiter	Pontiac, Oakland County.
H. H. Hinds	Stanton, Montcalm County.
F. E. Skeels	Harriette, Wexford County.
Dexter Horton	Fenton, Genesee County.

EX-PRESIDENTS.

Members Ex-Officio.

W. L. Webber	East Saginaw, Saginaw County.
George W. Phillips	Romeo, Macomb County.
William Chamberlain	Three Oaks, Berrien County.
A. O. Hyde	Marshall, Calhoun County.
T. W. Palmer	Detroit, Wayne County.

STANDING COMMITTEES AND EXECUTIVE SUPERINTENDENTS.

BUSINESS.

Eugene Fifield, H. H. Hinds and Secretary.

TRANSPORTATION.

L. J. Rindge, Eugene Jones, J. E. Rice.

PROGRAM.

Eugene Fifield, H. H. Hinds and Secretary.

PRINTING AND ADVERTISING.

I. H. Butterfield, Eugene Fifield, R. D. Graham.

RECEPTION.

S. O. Bush, L. J. Rindge, M. P. Anderson.

PREMIUM LIST.

W. E. Boyden, E. W. Hardy, John Lessiter, L. W. Barnes, F. L. Reed, Frank Maynard, John McKay.

RULES.

Eugene Fifield, H. H. Hinds, D. Horton.

FINANCE.

William Ball, F. E. Skeels, John McKay.

GENERAL SUPERINTENDENT.

Eugene Fifield.

CHIEF MARSHAL.

H. H. Hinds.

EXECUTIVE SUPERINTENDENTS.

Cattle—W. E. Boyden.
Horses, Speed—Eugene Fifield.
Horses, Roadster, Draft and Pony Classes.—H. H. Hinds.
Sheep—John Lessiter.
Swine—L. W. Barnes.
Poultry—C. A. Waldron.
Dairy, Bees and Honey—John McKay.
Farm and Garden Products—F. L. Reed.
Vehicles—Dexter Horton.
Agricultural Implements and Machinery—John A. Hoffman.
Manufactured Goods and Supt. of Main Building—F. E. Skeels.
Art—F. E. Skeels.
Needle Work and Children's Work—Mrs. F. E. Skeels.
School Exhibits—Frank Maynard.
Horticulture—R. D. Graham.
Gates—W. P. Custard.
Police—E. W. Hardy.
Forage—W. E. Boyden.
Booths and Privileges—H. R. Dewey.
Miscellaneous Exhibits—John McKay.

PROCEEDINGS OF THE EXECUTIVE COMMITTEE.

The Committee held a meeting called by the President at Sweet's Hotel, Grand Rapids, August 1, 1900, at 9 o'clock a. m., with the following members present: The President, Vice President, Secretary and Messrs. Fifield, Hinds, Ball, Jones, Barnes, Maynard, Horton, Hoffman, Hardy, Dewey, Reed, Lessiter, Boyden, McKay, Rice, Graham.

The President suggested the appointment of a clerk to the Finance Committee during the Fair. Mr. Erwin Ball was appointed.

Mr. Lessiter requested division of space for the sheep and swine departments. Referred to a committee, Messrs. Hinds, Ball, Barnes, Lessiter.

A request having been made by an exhibitor for a joint exhibit of carriages and farm implements. On motion of Mr. Ball, superintendents were instructed to locate exhibits in their several separate departments.

On motion of Mr. Boyden a typographical error in the premium list was corrected by adding in the cattle list, for heifers three years old the words, "or over."

By request of the Superintendent the matter of space for the dairy exhibit was referred to the Business Committee, Mr. Skeels and Mr. McKay.

Adjourned.

The Executive Committee met at Sweet's Hotel, Grand Rapids, on Monday evening, September 24, 1900, at 8 o'clock, the first day of the Fair. There were present the President, Vice President, Treasurer, Secretary, and Messrs. Fifield, Barnes, Custard, Ball, Boyden, Rice, Waldron, McKay, Hoffman, Maynard, Reed, Dewey, Graham, Hinds, Skeels, Horton.

The President called for reports from Executive Superintendents. Informal reports were made regarding exhibits in the several departments.

The matter of selling blocks of admission tickets at a discount being under consideration, Mr. Dewey moved that the Treasurer be authorized to sell tickets in lots of fifty, or more, to business firms at the usual rate (20 per cent discount). Carried.

After informal discussion Mr. Dewey's motion was reconsidered.

Mr. Hinds moved as a substitute "that the Treasurer be authorized to sell tickets in lots of fifty or more, to business firms who wish them for gratuitous distribution at forty cents each." The substitute was adopted and motion carried.

On motion of Mr. Graham Class 77, of 1899 (cut flowers), was added to the premium list for this year.

Mr. Jeremiah Boynton, who claimed to be a life member of the Northern Michigan Agricultural Society, which in 1873 was consolidated with the State Agricultural Society, made application for admission to the grounds for himself and family under said life membership, the certificate having been lost.

It was moved that the request be granted. Lost.

Mr. Fifield asked the opinion of the committee regarding the advisability of having an automobile race on the track during the Fair. Mr. Rindge moved as the sense of the committee that an automobile race would draw people to the grounds. Carried.

It was moved that the Secretary be instructed to call a caucus of the Society and issue the proper notices. Carried.

Hon. Robt. B. Loomis, of Grand Rapids, J. W. Cochrane, of Midland, and C. A. Sherrod, of Paw Paw, were appointed judges of election. It was moved that the election be held in the office of the superintendent of horses. Carried.

The committee adjourned.

ELECTION OF OFFICERS.

A caucus of the Society was held at the office of the President on Wednesday, September 24, at 4 o'clock p. m.

J. W. Cochrane was elected chairman, and E. N. Ball, secretary, C. J. Phillips and W. E. Boyden were appointed tellers.

The following nominations were made: For president, M. P. Anderson; for vice president, L. J. Rindge; for treasurer, C. W. Young; for secretary, I. H. Butterfield; for members of the executive committee for two years, Eugene Fifield, L. W. Barnes, W. P. Custard, William Ball, W. E. Boyden, Eugene Jones, J. E. Rice, C. A. Waldron, John McKay, John A. Hoffman.

The report of the committee on amendments to the constitution was presented as follows:

Your committee to whom was referred the advisability of making some changes in the constitution of the Society, would respectfully submit their report as follows:

We recommend that the last sentence in Article 2 be changed to read "the executive committee shall hold its annual meeting commencing on the second Monday in January in each year at 8 o'clock p. m of that day, and at such place as the president shall appoint."

In Article 4, insert "Business Committee" in place of "Executive Committee."

In Article 6, change last clause to read, "And shall make a full annual report of its proceedings."

In Article 7, in the last clause strike out the words, "Except orders for premiums."

In Article 14, after the word "Present," insert the words "And voting."

FRANK MAYNARD.
H. H. HINDS,
D. HORTON,
Committee.

The report was accepted and on motion the amendments were ordered to be voted on by ballot at the election on Thursday.

ELECTION.

The annual election for officers of the Society was held at the office of the superintendent of horses on Thursday, September 27, the polls being open from 9 o'clock a. m. to 5 o'clock p. m.

Hon. Robert B. Loomis and Mr. C. A. Sherrod, who had been appointed judges of election not being present, Mr. True Hart and Ezra Cole were appointed in their places. Mr. Ezra Cole was elected chairman, after closing the polls the votes were counted with the following result:

The undersigned judges of election at the annual meeting of the State Agricultural Society having duly counted the ballots cast at said election find the result as follows:

For president, M. P. Anderson, twenty-six votes.

For vice president, L. J. Rindge, twenty-six votes.

For treasurer, C. W. Young, twenty-six votes.

For secretary, I. H. Butterfield, Twenty-six votes.

For members of executive committee for two years, Eugent Fifield, L. W. Barnes, W. P. Custard, William Ball, W. E. Boyden, Eugene W. Jones, J. E. Rice, C. A. Waldron, John McKay and John A. Hoffman, each received twenty-six votes. Amendments to the constitution, yes, twenty-four votes; no, two votes.

EZRA COLE,
TRUE HART,
J. W. COCHRANE,
Judges of Election.

The president declared the persons above named elected and the amendments to the constitution carried.

THE FAIR OF 1900.

The annual fair was held on the grounds of the West Michigan Agricultural Society at Grand Rapids, September 24 to 28 inclusive. The weather was fine and the attendance larger than for any year since 1894.

The exhibit was up to the usual standard—after paying all expenses and premiums together with balance of debt a surplus was left as shown by the report of the treasurer.

WINTER MEETING, 1901.

OFFICERS FOR 1901.

President—M. P. ANDERSON, Midland.
Vice-President—L. J. RINDGE, Grand Rapids.
Treasurer—C. W. YOUNG, Paw Paw.
Secretary—I. H. BUTTERFIELD, Agricultural College.

EXECUTIVE COMMITTEE.

Term ending January, 1902.

E. W. Hardy	Howell, Livingston County.
Frank Maynard	Jackson, Jackson County.
F. L. Reed	Olivet, Eaton County.
S. O. Bush	Battle Creek, Calhoun County.
H. R. Dewey	Grand Blanc, Genesee County.
R. D. Graham	Grand Rapids, Kent County.
John Lessiter	Pontiac, Oakland County.
H. H. Hinds	Stanton, Montcalm County.
F. E. Skeels	Harriette, Wexford County.
Dexter Horton	Fenton, Genesee County.

Term ending January, 1903.

Eugene Fifield	Bay City, Bay County.
L. W. Barnes	Byron, Shiawassee County.
W. P. Custard	Mendon. St. Joseph County.
William Ball	Hamburg, Livingston County.
W. E. Boyden	Delhi Mills, Washtenaw County.
Eugene W. Jones	Grand Rapids, Kent County.
J. E. Rice	Grand Rapids, Kent County.
C. A. Waldron	Tecumseh, Lenawee County.
John McKay	Romeo, Macomb County.
John A. Hoffman	Kalamazoo, Kalamazoo County.

EX-PRESIDENTS.

Members Ex-Officio.

W. L. Webber	East Saginaw, Saginaw County.
George W. Phillips	Romeo, Macomb County.
William Chamberlain	Jackson, Jackson County.
A. O. Hyde	Marshall, Calhoun County.
T. W. Palmer	Detroit, Wayne County.

THE CONSTITUTION AS AMENDED IN 1900.

ARTICLE 1. The name of this association shall be the Michigan State Agricultural Society, and its objects shall be to promote improvements in Agriculture and its kindred arts throughout the State of Michigan.

ART. 2. The officers of this society shall consist of a president, vice-president, secretary and treasurer, who shall hold their offices for one year, and an executive committee of twenty members, ten of whom shall be elected annually to hold their offices for two years, the term of office to begin on the second Monday in January succeeding their election. All of said officers shall be elected by ballot by a majority vote of the members of the society voting at its annual meeting, which shall be held during the week of the fair, and shall hold their offices for the time named, or until others are elected or appointed in their places. All ex-presidents of the society elected prior to 1890 and the president, vice-president, secretary and treasurer, ex-officio, shall be members of the executive committee. Within ten days after any election of officers, the secretary shall give written notice to the persons so elected, and each of the persons so elected shall thereupon, within thirty days after the date of said notice, file with the secretary a written acceptance of the office. In case of neglect or refusal to do so the office to which he was elected shall from the time its duties would commence be deemed vacant, and such vacancy shall be filled by the executive committee, by ballot, at its next annual meeting. The executive committee shall hold its annual meeting at such place in the State as the president of the society shall appoint, and commencing on the second Monday in January in each year, at eight o'clock p. m. of that day.

ART. 3. The duties of the president and vice-president shall be such as usually pertain to their respective offices, and such as may be prescribed by the order of the executive committee, as hereinafter provided.

ART. 4. The treasurer shall receive and keep an accurate account of all moneys belonging to the society, being custodian of the tickets during the week of the fair, and shall sell the same from the treasurer's office as visitors may require; he shall pay out its moneys only on the order of the business committee, and at each annual meeting of the society he shall make a full report of its financial transactions and conditions.

ART. 5. The executive committee shall determine the time for holding each annual meeting and fair of the society, and it shall call that meeting and fair at such times as it shall judge best, between the first Monday in September and the third Monday in October, giving at least sixty days' notice thereof.

ART. 6. The executive committee shall direct the money appropriations of the society and have control of its property; it shall make the necessary preparations for the annual fair, and issue all proper public notices and circulars in relation thereto, or to the general object of the society. It shall prepare the necessary by-laws of the society, and may prescribe such duties to the other officers of the society as are not inconsistent with the usual business of their respective offices; it shall itself obey the instructions which may be given to it at the annual meeting of the society, and at the expiration of its term of service shall make a full annual report of its proceedings.

ART. 7. The executive committee shall appoint, at its annual meeting, from among its members, a general superintendent, who, with the secretary and one other member to be elected by the executive committee, shall constitute a business committee, of which the general superintendent shall be chairman. The business committee shall transact such business as it may be authorized to do by the executive committee. The chairman of the business committee shall countersign all orders on the treasurer for the payment of any money directed by the executive committee to be paid for any purpose; and the secretary shall keep an accurate account of all orders so drawn.

ART. 8. The secretary shall keep an accurate account of all moneys received by him, showing by items the source from whence received, and such moneys shall be paid over to the treasurer by him without abatement. The secretary shall make a report to the society, at the meeting of the executive committee next after each annual meeting and fair of the society, which report shall state by items all moneys received by him, and shall also state the dates at which the same were paid over to the treasurer, and the amount paid at each time. Such report shall also show all warrants drawn on the treasurer, and the specific purpose for which each warrant was drawn. The secretary shall also perform such other duties as the executive committee shall from time to time prescribe.

ART. 9. The officers and members of the executive committee shall receive no compensation whatever for their services (except the secretary, treasurer and business committee), but all members of the executive committee, except honorary members, shall be entitled to have their actual necessary expenses, while engaged in the performance of their duties as such, paid from the treasury of the society. The secretary and treasurer shall be entitled to such salary annually as the executive committee shall from time to time fix.

ART. 10. It shall be the duty of the executive committee annually to offer and award premiums on such articles, animals, productions and implements as it may beem best calculated to promote the agricultural, horticultural, manufacturing, mining and household interests of the State, and it shall also authorize the secretary to prepare a report of all transactions of the society during the preceding year, embracing such valuable reports from committees, statements of experiments, cultivation and improvements, proceedings of county societies, correspondence, statistics and other matters, the publication of which will exhibit the condition of the agricultural interests of Michigan, and a diffused knowledge of which will, in the judgment of the committee, add to the productiveness of agricultural and household labor, and therefore promote the general prosperity of the State; and, as soon as practicable, the committee shall transmit such report and abstract to the president of the senate for the use of the legislature.

ART. 11. Any person may become a member of this society for one year by paying one dollar into the treasury.

ART. 12. The secretaries of the different county societies shall be considered corresponding secretaries of this society.

ART. 13. The secretary and treasurer shall give such bonds for the faithful performance of their duties in such sums as may be determined by the executive committee. Said bonds to be approved by the president as to form and sufficiency of sureties, and his approval shall be endorsed thereon, and such bonds, and the action of the president thereon shall be reported to the executive committee at its annual meeting, and shall be subject, both as to form and sufficiency, to the action of the executive committee, and when accepted, shall be deposited with the president for safe keeping.

ART. 14. This constitution shall be altered only by a vote of two-thirds of the members present and voting at an annual meeting of the society. This constitution to become operative on the second Monday in January, 1891.

The executive committee met at Sweet's Hotel, Grand Rapids, on Monday, January 14, at 8 o'clock p. m., with the following members present: President Anderson, Vice President Rindge, Treasurer Young, Secretary and Messrs. Fifield, Barnes, Custard, Ball, Boyden, Jones, Rice, Waldron, McKay, Hoffman, Hardy, Maynard, Reed, Bush, Dewey, Graham, Hinds, Skeels, Horton and ex-President Chamberlain.

Minutes of meeting of August 1, 1900, and September 24, read and approved.

After hearing from citizens of Kalamazoo and Grand Rapids in relation to the place of holding the fair of 1901, a recess was taken to Tuesday morning at 9 o'clock.

Tuesday, January 15, 9 o'clock a. m., President Anderson presented his address as follows:

ADDRESS OF PRESIDENT M. P. ANDERSON.

Gentlemen of the Executive Committee:

In compliance with the past custom of this Society, I address you at this our annual meeting. I wish to take this opportunity to thank you for courtesies shown in the past and your confidence in again calling me to the station of presiding officer. I feel very grateful for the compliment and assure you that I appreciate it. I have undoubtedly made many mistakes, but they were not purposely made, and hope you will overlook them, as I have tried to do my duty as far as I was able to see it.

The past or fifty-first annual exhibition closed the nineteenth century. I wish to extend congratulations that we are enabled to enter the new or twentieth century entirely free from debt, with a comfortable balance in the treasury. A large number of you have participated in bringing the Society out of an indebtedness in 1893 of over $25,000. It is with no little pride and much pleasure that I am able to make this announcement. I thought we had the matter of management about as complete as might be, but as the conditions change I believe some changes should be made to meet them. For years the executive members have spent their valuable time for several days during the busy season of the year, working nearly day and night without compensation for the welfare of the society. While we were in debt I, for one, felt like using economy in every branch until we were able to close an exhibition, pay our debts and have a comfortable balance on hand. We have reached that point, and now I would recommend that Article IX of the constitution be changed to fix the pay of all the members not now provided in said article a per diem of $3.00 during the preparing and continuance of the fair, commencing on Thursday preceding the fair week, ending on Saturday following the close of the exhibition, not exceeding ten days, this to be in addition to actual expenses now provided; and that the president have a fixed amount as salary for the entire year, not to exceed $100 and actual expenses. It is asking too much of the class of gentlemen who compose this board to spend their valuable time at a loss from their personal business.

PREMIUM LIST.

The premium list should have a careful revision and make such increases in the offerings as will attract a larger number of exhibitors. We have a few new counties in the northern part of the State that are developing into fine farming and fruit growing districts. Take the counties of Emmet, Cheboygan, Presque Isle, Charlevoix, Montmorency and Alpena, place them in groups of three or four and offer $75 or $100 to each group making the best exhibit of grains, vegetables and fruits. Variety and quality of exhibits to govern the award. Arranging the groups so that the counties would be as near as possible in the same class relating to location, settlement, temperature, etc. A few hundred dollars put up in this way might be of much benefit to both Society and to that part of our State.

Each superintendent, I hope, will study out his department carefully and make such recommendations to the premium list committee as will enable them to reach a larger number of exhibitors.

RECEIPTS AND DISBURSEMENTS FOR 1900.

Total receipts from all sources	$25,830 53

DISBURSEMENTS.

Total business orders including speed	15,568 29
Total premium orders	6,718 25
Balance on hand	3,543 99

PRINTING AND ADVERTISING.

The manner of printing and advertising as adopted the past two years proves to be more successful than any other method formerly employed, especial mention being made to the sending out of personal letters, etc. I would urge its continuance.

TRANSPORTATION.

The arrangements with the several railroad companies made last year proved very satisfactory, and I trust a continuance of the same may be had.

EXHIBITORS' TICKETS.

This is a bone of contention. This privilege is most wantonly abused. Besides the exhibitors' tickets used last year, there were 1,460 buttons attached. If it were possible I would like to see the button business done away with entirely. In addition to the buttons used there were 1,530 single admissions issued, making a total of 2,990. I believe if exhibitors' tickets were issued by the superintendents, furnished in books to be countersigned by them, we would avoid much displeasure and the number of admissions would not be increased. I would like to see it have a fair trial and a report made by the chairman of the finance committee of the number taken in at the gates.

GRANGE RECORD.

Last year a small premium was offered to attract and bring out representations from the different Granges. This proved to be attractive and I believe, if followed up, will add greatly in bringing visitors to the fair. A record was kept and a report made to the Society at the close of the fair, showing a registration of over 400. I would recommend that each member be provided with his or her credentials and that a stamp with the words "Registered, 1901," be stamped upon the credentials when the member is recorded.

EXHIBITS.

The class of exhibits for 1900 was very good indeed, but the quantity, I believe, can be increased by a careful revision and increase in the offering of premiums, especially in the live stock department.

ATTRACTIONS.

The varied class of amusements and the manner in which they were conducted was well received, as was shown by the immense crowd that thronged the grand stand, which proved altogether too small. I believe we should not depart from the program as used the past two years.

BOOTHS AND PRIVILEGES.

No department is more difficult to manage than this. The revenue derived from the lease of ground pays many dollars in premiums and the cost incurred is very insignificant compared with the income. I know the superintendent the past two years has been harassed beyond description, but while in the most despairing work the fact that the Society was still in debt would appear and he would lay aside all personal feelings and re-enter the arena either to "conquer or die." Now that the vision of debt is wiped away I would recommend that the superintendent be provided with at least two private detectives, to be selected by him, to patrol the department without badges (visible) and promptly report to the superintendent any violating their contract. The criticism brought upon this branch has been caused by the dishonest tenants, who lease the ground for a certain purpose and in the absence of the superintendent convert it into some fakir game. By the aid of private ununiformed detectives this can be promptly detected and closed up.

PROMPT ATTENDANCE OF SUPERINTENDENTS.

I called attention to this in my report of last year, and was much pleased with the promptness of each. All, I believe, were on hand except our honorable member, Mr. John Lessiter, who was too ill to attend, his department being cared for by ex-President Ball very satisfactorily to the exhibitors.

SCHOOL EXHIBITS.

Under the able management of Superintendent Maynard this department has made wonderful progress. He has aroused so much interest in it that it has come to stay, and I trust you will lend your support to the superintendent in maintaining this feature.

POLICE.

While the superintendent of police was kept away from the personal supervision of his department, he was assisted by able and experienced men, and the large crowds were well and carefully handled.

IN CONCLUSION.

There is much that should be considered before another exhibition is to be held. The Pan-American Exposition at Buffalo should be well considered.

Criticisms from certain ones who had fancied wrongs are familiar to the present members. The location and many other important matters should be well considered before acting.

On motion a committee of three was appointed to consider the subjects presented in the address of the president and report thereon. Mr. Graham, Mr. Horton and Mr. Maynard were appointed such committee.

Reports from executive superintendents were received as follows:

REPORTS OF EXECUTIVE SUPERINTENDENTS.

REPORT OF SUPERINTENDENT OF CATTLE.

To the officers and members of the Executive Committee of the Michigan State Fair:

Gentlemen—As superintendent of cattle department I beg to report as follows: Number of entries, 285; amount of premiums offered, $2,424; amount awarded, $1,740.

The show as a whole was very good, and especially fine in the shorthorn class. So far as I know the exhibitors seemed well pleased with the treatment received at the fair of 1900. The expenses of this department including judges and superintendent was $58. All of which is respectfully submitted.

W. E. BOYDEN,
Superintendent of Cattle.

REPORT OF THE SUPERINTENDENT OF SHEEP.

To the President and Executive Committee of the State Agricultural Society:

Gentlemen—Mr. John Lessiter, superintendent of sheep, on account of sickness was unable to attend to the duties of the position. At a very late date, four days before the first day of the fair, I reluctantly consented to care for the department.

The exhibitors of sheep in all or nearly all classes was exceptionally good. No friction occurred and everything moved on satisfactorily.

Following is the report of entries in said department together with premiums offered and premiums awarded and paid as shown by the proceedings. Report of which is here attached:

In a measure, at least, the rules for entry are entirely disregarded. The exhibitors very seldom comply with rule No. 12, in live stock division. I failed to find a single instance in which the rule for sheep requiring manner and date of shearing to be given at time of entry was complied with. I do not know of an instance where an exhibitor was required to prove the registry of his sheep in any of the designated registers. I find nothing in the rules which points out whose duty it is to require exhibitors to comply with the rule. As I understand the object of the Society in offering premiums to the different breeders of sheep (as well as other stock) is to demonstrate the value of different families of sheep best for specific purposes. The premium list offers premiums in thoroughbred American Merino, Rambouilett Merinos and Delaine Merinoes. Dickinson or Black Tops. Last fall if a breeder had a good sized sheep with a fleece that would pass as a Delaine wool, it was put into a Delaine class whether it was bred for such purposes or whether it happened to be a "sport" or an accident, whether it belonged to the class legitimately or not. Some plan should be devised that would oblige exhibitors to comply with the intent of the rules and be prepared with the proper registers to show for what purpose and in what register the sheep is recorded. Either throw out the Delaine class or define it explicity so that the Delaine breeder who is spending his time and money in developing that class of sheep shall be protected against the practice of Merino exhibitors (who happen to have a plain bodied, long fleeced and, as a rule, heavier fleeced one, of placing them in the competition with a class in which they do not belong. At the last fair the sheep space was inadequate for the comfort and convenience of exhibitors. As a rule the pens were too much crowded. The sheep were scattered over too much space and it was very fatiguing to bring sheep from the north swine building (where some were located) to the place of exhibitors. No proper place is provided in which to exhibit sheep. They had to be shown in the driveway, in cattle barns or aisles, or in the opening between buildings. Either more space should be furnished or exhibitors should not have room for so many sale sheep as are in the habit of occupying space which properly belongs to sheep, which are entered for only exhibition purposes. Two points are to be considered, the Society and the exhibitors and also the visitor. All should be treated with justice and fairness.

All of which is respectfully submitted.

WILLIAM BALL,
Acting Superintendent.

The number of entries, amount offered and amounts rewarded in the several classes will be found in the report of the secretary.

REPORT OF THE SUPERINTENDENT OF POULTRY.

To the President and Executive Committee of the Michigan State Agricultural Society:

Gentlemen—As superintendent of Division E, Poultry, I would submit the following report:

DIVISION E. POULTRY.

	No. of entries.	Amount offered.	Amount awarded.
Asiatic class	188	$48 00	$41 50
American	243	69 00	55 50
Bant. other than Game	110	78 00	43 00
English Class	9	18 00	5 50
Game and Game Bant	100	113 00	34 00
Mediterranean	172	60 00	46 50
French Class	19	18 00	6 00
Hamburg Class	31	33 00	8 50
Polish Class	42	30 00	16 50
Miscellaneous	26	24 00	5 50
Turkey Class	34	18 00	10 00
Ducks Class	37	15 00	14 00
Goose Class	26	15 00	14 00
Ornamental	14	12 00	6 00
Pigeon	5	3 00	3 00
Totals	1,056	$543 00	$302 00

C. A. WALDRON,
Superintendent.

FARM AND GARDEN PRODUCTS.

To the President and Executive Committee of the Michigan State Agricultural Society:

The entries in Division F at the fair, 1900, were in classes 43, grains and seeds, 141; premiums, offered 134; awarded, 108. Class 44 and 45, roots and vegetables, entries 320; premiums offered, $195.50; awarded, $167.00. Total number of entries, 462; amount awarded, $275.00; offered, $329.50. A very interesting feature of the exhibit was the display by the Agricultural College of the vegetables, grains and fruits from the Experiment Station of the Upper Peninsula. The people generally were very much surprised to see such a fine display of growth of apples and other fruit as well as corn and other grain, and I may say that they kept Mr. Geismar very busy answering questions in regard to the soil and general features of that part of the State.

Respectfully submitted,
F. L. REED.

DAIRY, BEES AND HONEY.

Mr. President and members of the Executive Committee of the Michigan Agricultural Society:

Superintendent of Division H would offer the following report:

The exhibit in this class was small but very good. There were only two exhibitors. Number of entries, 23; premiums offered, $134.00; premiums awarded. $68.00.

All of which is respectfully submitted.

JOHN McKAY,
Superintendent.

PRESERVED FRUITS, JELLY AND VEGETABLES.

I do not know much about this class. It was over in Mr. Graham's building and he very kindly took charge of it. Would recommend that class 49 be placed in Division P. It properly belongs in the same department with fruits.

All of which is respectfully submitted.

JOHN McKAY,
Superintendent.

DAIRY AND OTHER PRODUCTS.

To the President and Executive Committee of the Michigan Agricultural Society:

Superintendent of Division G offers the following report:

The exhibits in class 47. butter and cheese were larger than usual. I think at least that there was more than we had room for. It will be necessary to provide better accommodations for this department at the next fair. Number of entries, 52; premiums offered, $150.00, and awarded $134.00. Class 48 sugar and bread, number of entries, 58. The show in these classes was very good. Class 49, dried, canned pickled.

VEHICLES.

FENTON, MICH., Jan. 12, 1901.

To the Executive Committee of the Michigan State Agricultural Society:

The superintendent of exhibits in Division J, vehicles, would respectfully report number of entries, 36; number of rewards, 12; diplomas, 11; silver medals, 1; number of exhibitors, 24.

All kinds of prices, grades and styles were exhibited. The latest and most fashionable styles were shown and by builders, who have a reputation for quality, work and oraginality of design. There was also a large and varied line of medium or lower priced goods and the best line of cheap work for the money that I ever saw together. Both dealer and manufacturer seemed to realize the importance of attending this fair and from information collected on the spot both were satisfied.

The space designated was all occupied and more could have been used to advantage. Except for crowding exhibitors of the same quality, grade and price together, which occasioned some little annoyance, but their was usually good feeling. There might have been some kicking but not loud as it did not come to my ears. I can bear testimony to the uniform courtesy and kindness with every exhibitor in my department.

The question of tents or arranging for covers for the exhibits is one annoying to the superintendent, exhibitors and business committee. I am satisfied that the renting of tents by the society should be abandoned entirely, as a better way would be in my opinion to allow exhibitors a certain sum to furnish their own tents. (The premiums abandoned which are only.)

The grounds are very rough and uneven and if occupied this year by the same department it should, at least be smoothed up a little, and drained and then just a few days before the fair mowed and cleaned off. The expense would be very small.

The total expenses including three trips to Grand Rapids, hotel bills, etc., $40.59.

I am but saying what is true when I say that the president, secretary, business committee, kept me in line and it affords me much pleasure to thank them and to say that but for their assistance my department would not have been so successful, pleasant, easy and so little friction.

Respectfully submitted,

D. HORTON,

Superintendent of Vehicles.

FARM IMPLEMENTS AND MACHINERY.

Mr. President and members of the Executive Committee:

Gentlemen—I beg leave to submit to you my report as superintendent of farm implements and machinery at the late fair held in this city. We had a very fine show of farm implements, visitors and exhibitors seemed to be well pleased. We did a great deal of correspondence and went to some expense to bring this about. It was, however, the means of bringing new exhibitors here, before unknown to the Michigan State Fair, as well as exhibitors who have not attended our fairs for many years past. I recommend that my successor be urged to continue the correspondence with manufacturers of the United States, setting forth the advantages of our fair.

Respectfully submitted,

JOHN A. HOFFMAN.

FINE ARTS.

Officers and members of the Executive Committee of the Michigan State Fair Association:

Gentlemen—As superintendent of art hall I desire to report a very satisfactory exhibit in an important department of our fair. Many of the larger exhibits in manufactured goods were not entered for any competition, but for the purpose of making a display.

In the department of manufactured goods, musical instruments, etc., we offer seventy-four diplomas, one silver medal and $46.00 in cash; of these we awarded $13.00, no diplomas or medals.

In the department of art we offer $647.00 in cash and 21 diplomas, of which we awarded, in professional painting, $389.50; in amateur painting, $75.25; in industrial art, ten diplomas and $44.00 in cash, being a total of $508.75 and ten diplomas. Six diplomas were recommended upon non-enumerated articles of merit.

The decorations displayed by some of the firms in the main building were exceptionally beautiful, and attracted much attention. On the whole the exhibits were fully up to the standard usually shown in this department. Many local firms caused the superintendent much anxiety by applying for space and deciding at the last moment that "pressure of business" would prevent the exhibit being placed. A portion of the building was set aside for an exhibition given by the Hadley Wagon Co. and formed a new and pleasing feature. The dairy, bees and honey were also accommodated in art hall and the display in these departments could have been made much more attractive had we known more nearly the amount of space required. We think these changes are for the good and that a breaking away from some of the old exhibits is desirable.

Respectfully submitted,
F. E. SKEELS,
Superintendent.

NEEDLE WORK.

To the Officers and members of the Executive Committee of the Michigan State Fair Association:

Gentlemen—As superintendent of the needle work and children's department. I wish to make the following report: We had in this branch of the fair 380 entries, of which 125 were in the professional class, $107.50 were offered and $95.75 were awarded. One hundred fifty-six entries were made in the amateur department and $46.75 of the $70.25 offered was awarded; seventeen entries were made in the amateur and professional class with $17.50 offered and $8.25 taken; in crochet and knit work there were 60 entries, $28.50 offered and $22.50 taken. In children's work 13 entries were taken, $20.00 offered and $10.25 taken.

The total number of entries in this division was 380, with $243.75 offered, and $183.50 taken. Much advancement is being made in this class of work and it will be almost necessary to add some new features to the next premium list issued in order to keep in pace with the newer work. At the proper time we would recommend to the premium list committee that a number of such additions be made as will serve to draw out some work that is of merit and not now enumerated.

Respectfully submitted,

MRS. F. E. SKEELS,
Superintendent.

FRUIT AND FLOWERS.

The exhibit was good and the quality of fruit fine. With a total of 798 entries. For entries in the several classes see report of secretary.

MISCELLANEOUS.

Mr. President and Gentlemen of the Executive Committee of the Michigan Agricultural Society:

Superintendent of Division R, class 78, there were no entries. Class 79, 4 entries, 18 diplomas offered, I awarded. There were a number of articles on exhibition in this class that were not entered. Owners seemed to wish to merely exhibit their goods.

All of which is respectfully submitted.

JOHN McKAY,
Superintendent.

SCHOOL EXHIBIT.

To the President and Executive Committee of the Michigan State Agricultural Society:

The exhibit in the school department, Division S at the fair of 1900 was, I believe, the largest ever made at any fair of this Society.

The total number of entries in this division was 234. There was offered $360.00 and a total of $340.00 awarded. The exhibition was tastefully arranged and attracted the admiration of a large crowd of visitors each day of the fair. There is manifestly a growing interest in the school department—it is an important and worthy of the best thought and encouragement of this Society.

FRANK MAYNARD,
Superintendent.

BOOTHS, RENTS AND PRIVILEGES.

To the President and the Executive Committee of the Michigan State Agricultural Society:

Gentlemen, I would respectfully report—

My receipts from my personal allowances for 1900	$1,675 93
My receipts from all other sources	988 25
Making a total of	$2,664 18

My receipts from my personal collection were $26.38 more in 1900 than in 1899.

My receipts from other sources were $243.95 less in 1900 than in 1899.

Leaving my total collections for 1900 $243.95 less than in 1899, the high water mark.

My pay roll for 1900 was $172.33, being $57.95 more in 1900 than in 1899 on account of having more men.

Respectfully submitted,
H. R. DEWEY,
Superintendent.

GATES.

To the President and members of the Executive Committee of the Michigan State Agricultural Society:

Gentlemen—Being superintendent of the gates I make the following report:

I employed thirteen men to tend gates at $2.50 per day each and their railroad fare one way or excursion rates. They paid their own board; and three men to attend grand stand doors at $1.00 per day each, making a total of $174.50 paid for gate labor, all of which is respectfully submitted.

W. P. CUSTARD,
Superintendent of Gates.

POLICE.

To the President and members of the Executive Committee of Michigan State Agricultural Society:

Gentlemen—With the able assistance of help the Society received from officers of Grand Rapids, the department of police ran very smoothly.

Pay roll of police department	$502 70
Fines collected	1 30

Respectfully submitted,
E. W. HARDY,
Superintendent of Police.

COMMITTEE ON PRESIDENT'S ADDRESS REPORTED AS FOLLOWS:

Your committee to whom was referred the report and accompanying recommendation of the president beg leave to report as follows:

As a whole we look upon the report as able and wise. As to certain recommendations we desire to offer some suggestions to be acted upon by this body. First, as to compensation of superintendent's and president's salary we concur in recommendation.

Second, as to recommendation regarding special inducements to exhibitors from northern counties we recommend that the secretary correspond with the management of the various railroads traversing such counties for the purpose of securing special premiums for exhibits of fruits and general farm products. We believe this system to be very satisfactory both to the railroads and exhibitors and certainly to this Society.

As to the matter of exhibitors' tickets, your committee are of the opinion that our present system, i. e., wearing either the button or the ticket in the discretion of the superintendent is preferable to either system alone. We therefore recommend that the present plans be continued and that a suitable plan be provided for the button man. As to the plan of offering premiums or special inducements to organizations for the largest attendance at the fair, your committee do not concur in the recommendations in the address for the following reasons: viz, first, the Society gets no adequate return for the money. Second, it is an unjust discrimination against such organizations located at a distance. Third, if one class of associations are entitled to such privileges they all are equally entitled. We recommend that it be discontinued.

We concur in the recommendation regarding special attractions and the recommendations relating to the employment of detectives, believing it to be to the best interests of the Society to maintain the utmost purity of exhibits and attractions.

All of which your committee respectfully recommend.

R. D. GRAHAM.
D. HORTON.
FRANK MAYNARD.

THE SPEED DEPARTMENT.

There were 88 entries in the speed department, and the races were conducted under the rules of the American Trotting Association.

The following is a summary of the receipts and expenses which the superintendent considers should be credited and charged respectively to this department, showing that the races brought in more than they cost:

	Dr.	Cr.
To purses paid out	$2,910 00	
To membership A. T. Asso.	35 00	
Total	$2,945 00	
By entrance money paid in		$1,395 00
By collected since fair		22 50
By entrance money Lulu M., 1899		15 65
By entrance money Yosemite, 1899		15 00
By cash pool and score card privilege		660 00
By one-half paid admission to grand stand		898 62
By entrance "Producer," suspended, 1899		15 75
Total receipts		$3,022 52
By balance	77 52	
Total	$3,022 52	

EUGENE FIFIELD,
Superintendent.
GEO. S. WARD,
Clerk.

REPORT OF THE SECRETARY.

Gentlemen, of the Executive Committee, I have received during the year the following amounts in cash:

For memberships sold	$368 00
From stall rents paid	172 30
From speed fines paid	47 35
From subscriptions for shorthorn premiums	35 00
Total	$623 65

Which has been paid to the treasurer.

I. H. BUTTERFIELD,
Secretary.

The report was accepted and referred to the finance committee.

The secretary reported as follows:

STATE FAIR, 1900.

The following shows the number of entries in each class, the amount offered, amounts awarded and totals:

Cattle.

		Entries.	Total offered.	Awarded.
1.	Shorthorns	91	$285 00	$463 00
2.	Devons	20	285 00	196 00
3.	Herefords	47	285 00	267 00
4.	Jerseys	28	285 00	190 00
5.	Galloways	32	285 00	227 00
6.	Angus	0	285 00	......
7.	Holstein	15	285 00	57 00
8.	Red Polled	40	285 00	260 00
9.	Fat Cattle	12	144 00	80 00
	Totals	285; 8 dip.	$2,424 00	$1,740 00

Horses.

10.	Standard Bred	27	$267 00	$193 00
11.	Roadsters	25	138 00	61 00
12.	Carriage	17	160 00	115 00
13.	Saddle	3	36 00	36 00
14.	All work	17	236 00	113 00
15.	Cleveland Bays	5	235 00	37 00
16.	French Coach	1	235 00	14 00
17.	Hackneys	1	235 00	......
18.	Percheron	15	235 00	107 00
19.	Clydesdale or Shire	4	235 00	39 00
20.	Grade Draft	7	133 00	35 00
21.	Shetlonds	0 13 dip.	......	......
	Totals	122	$2,135 00	$750 00

Speed Department.

Entries	88	$3,450 00	$2,910 10

Sheep.

22.	American Merinos	53	$168 00	$163 00
23.	Rambouillet Merinos	53	126 00	119 00
24.	Delaine	67	126 00	126 00
25.	Lincoln	8	114 00	55 00
26.	Leicester	46	114 00	114 00
27.	Cotswell	56	114 00	102 00
28.	Shropshire	157	126 00	126 00
29.	Hampshire	17	114 00	81 00
30.	Oxford	33	114 00	102 00
31.	Southdown	36	114 00	102 00
32.	Dorset	29	114 00	83 00
33.	Fat sheep	8	54 00	30 00
	Totals	563	$1,398 00	$1,203 00

		Entries.	Total offered.	Awarded.
	Swine.			
34.	....	51	$132 00	$70 00
35.	Essex	..	132 00	......
36.	Small Yorkshire	27	132 00	114 00
37.	Poland Chinas	56	132 00	109 00
38.	Duroc Jersey	10	132 00	58 00
39.	Chester White	14	132 00	58 00
40.	Victoria	49	132 00	127 00
41.	Tamworth	17	132 00	62 00
	Totals	224	$1,056 00	$598 00
	Poultry.			
42.	Totals	1,052	$543 00	$300 50
	Farm Products.			
43.	Grains and Seeds	141	$134 00	$108 00
44 and 45.	Roots and Vegetables	321	195 50	167 00
	Totals	462	$329 50	$275 00
	Dairy and Domestic Products.			
46.	Butter and Cheese	52	$150 00	$134 00
47.	Sugar, Bread, etc	58	51 00	38 00
48.	Preserved Fruits	39	90 00	90 00
	Totals	149	$291 00	$262 00
	Bees and Honey.			
51.	Total	23; one dip.	$134 00	$68 00
52.	*Farm Implements.*			
	Vehicles.			
53.	Totals	36	14 diplimas. 1 sil. med. 1 silver cup, 3 yrs.	11 diplomas. 1 medal.
	Manufactures.			
54.	Materials	5	$46 00	$13 00
55.	Leather	0	16 dip.	......
56.	Furniture	1	33 dip. 1 S. M.	......
57.	Stoves and Iron work	0	16 dip.	......
58.	Clocks, Jewelry, etc.	0	9	......
	Totals	6	1 med., $46 74 dip. 113 dip. 2 S. medals.	$13 00
	Art.			
59.	Painting, Professional	138	$467 00 2 dip.	$389 50
60.	Amateur	71	99 00 1 dip.	72 25 10 dip.
61.	Industrial Art	27	79 00 18 dip.	44 00
	Totals	236	$645 00 21 dip.	$508 75 10 dip.

Needlework.

		Entries.	Total offered.	Awarded.
62.	Professional	125	$107 50 1 dip.	$95 75
63.	Amateur	156	70 25	46 75
64.	Professional or Amateur	17	17 50	8 25
65.	Crochet and Knit	69	28 50	22 50
66.	Children's Work	13	20 00	10 25
	Totals	380	$243 75 1 dip.	$183 50

Horticulture.

	R. R. Specials.						
	G. R. & I.	6		$100 00		$100 00	
	Pere Marquette	5		90 00		60 00	
	Total	11		$190 00		$160 00	
	Regular.						
67.	Artistic exhibits	4		38 00		38 00	
68.	Coll. Family use	6		60 00		60 00	
69.	Coll. Market	0		44 00		37 00	
70.	Spec. Ex. Peaches	7		36 00		28 00	
71.	Spec. Ex. Pears	7		36 00		28 00	
72.	Spec. Ex. Plums	6		17 50		14 00	
73.	Spec. Ex. Grapes	11		33 50		21 00	
74.	Plates Fruit	619		12 50		161 00	
			666		$477 50		$387 00
	Flowers.						
75.	Plants in pots	36		$182 00		$140 00	
76.	Plants in pots, Amateur	47		72 00		47 00	
77.	Cut Flowers	38		81 50		64 59	
			121		335 50		251 50
	Total Horticulture		787		$813 00		$638 50

Miscellaneous.

78.	Miscellaneous articles	0	38 dip.	......
79.	Household Art	4	18 dip.	1 dip.
	Total	4	46 dip.	1 dip.

School Work.

High Schools	30	$30 00	$30 00
Graded or Village	30	70 00	62 00
District	23	50 00 1 dip.	46 00
Total	83	$150 00 1 dip.	$138 00

Specials by Citizens of Grand Rapids.

High Schools	53	$60 50	$58 50
Grammar	54	78 00	77 00
Primary	39	62 00	62 00
Kindergarten	5	10 00	5 00
Total	83	$210 50	$202 50

Total Regular Entries	4,251	$10,188 25	$6,698 25
Total Special	162	400 50	352 00

REPORT OF THE BUSINESS COMMITTEE.

MICHIGAN STATE AGRICULTURAL SOCIETY, 1900.

Statement of the Business Committee in Detail.—Winter Meeting.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Feb. 20	1	Frank Maynard, personal expenses.......	$2 84	
	2	W. E. Boyden, personal expenses..........	6 80	
	3	John Lessiter,personal expenses..........	6 95	
	4	Frank Maynard, personal expenses........	5 84	
	5	H. R. Dewey, personal expenses..........	7 60	
	6	E. W. Hardy, personal expenses...........	5 95	
	7	F. L. Reed, personal expenses............	8 74	
	8	F. E. Skeels, personal expenses..........	7 52	
	9	R. D. Graham, personal expenses..........	1 50	
	10	John McKay, personal expenses..........	8 55	
	11	L. W. Barnes, personal expenses.........	5 70	
	12	Eugene Fifield, personal expenses.........	10 20	
	13	D. Horton, personal expenses.............	6 90	
	14	H. H. Hinds, personal expenses..........	4 70	
	15	C. A. Waldron, personal expenses.........	6 86	
	16	M. P. Anderson, personal expenses........	9 95	
	17	W. P. Custard, personal expenses........	4 60	
	18	C. W. Young, personal expenses..........	5 90	
				$117 10
		Business Committee.		
Sept. 28	56	H. H. Hinds, personal expenses...........	$51 21	
	79	E. M. Sharp, services and expenses........	35 45	
	84	Eugene Fifield, personal expenses........	64 51	
	122	Eugene Fifield, salary chairman..........	200 00	
				351 17
		Finance Committee.		
	60	Wm. Ball, personal expenses............	$14 05	
	61	Erwin Ball, clerk, services and expenses....	15 45	
				29 50
		President's Office.		
	45	J. W. Cochrane, services.................	$24 10	
	47	True Hart, services.....................	6 00	
	48	Grace P. Anderson, services and expenses..	19 00	
	49	M. P. Anderson, personal expenses........	38 90	
				88 00
		Secretary's Office.		
	92	I. H. Butterfield, part salary	$375 00	
Oct. 22	116	I. H. Butterfield, balance of salary.......	200 00	
Sept. 29	103	I. H. Butterfield, expenses..............	62 22	
Dec. 11	131	I. H. Butterfield, expenses...............	10 30	
				647 52
		Treasurer's Office.		
Oct. 23	118	C. W. Young, treasurer, pay roll office.....	$119 00	
	135	N. B. Miller, livery....................	5 00	
	136	C. W. Young, sundry expenses............	26 96	
	119	C. W. Young, expenses and help..........	47 26	
	121	C. W. Young, salary and help............	250 00	
				448 22

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
		Cattle Department.		
Sept. 28	39	W. E. Boyden, exp. supt. and judge......	$58 00	$58 00
		Horse Department.		
Sept. 28	41	W. H. Loucks, judge expenses............	$15 00	
	56	H. H. Hinds, supt. and expenses.........	31 90	
				46 90
		Speed Department.		
Sept. 26	25	Geo. S. Ward, dues to Am. T. Ass'n......	$35 00	
" 26	26	Eugene Fifield, to pay purses............	1,500 00	
" 27	27	Eugene Fifield, to pay purses............	900 00	
" 28	29	Eugene Fifield, to pay purses............	600 00	
" 29	65	W. F. Adams, starting judge...........	34 50	
	69	Geo. S. Ward, clerk services............	125 25	
	73	Powers Tyson Ptg. Co., printing.........	41 00	
	84	Eugene Fifield, track expenses...........	16 50	
	90	Geo. S. Ward, advertisements paid.......	30 00	
Feb. 20	102	Geo. S. Ward, services and expenses.....	35 42	
				3,317 67
		Sheep Department.		
Feb. 28	60	Wm. Ball, supt. expenses and judge......	$30 06	
	137	J. Lessiter, expenses summer meeting....	5 95	
Nov. 9	129	H. W. Mumford, judge, services and exp...	14 95	
				50 96
		Swine Department.		
Sept. 28	43	L. W. Barnes, expenses supt. and judge..	$32 80	32 80
		Poultry Department.		
Sept. 28	53	C. A. Waldron, expenses supt. and judge..	40 00	40 00
		Farm and Garden Department.		
Sept. 28	52	F. L. Reed, expenses supt. and judge....	35 36	35 36
		Dairy, Bees and Honey.		
Sept. 28	54	John McKay, expenses supt. and judge....	46 24	
			3 95	
				50 19
		Farm Implement Department.		
Sept. 29	97	John A. Hoffman, expenses superintendent	$40 71	40 71
		Vehicle Department.		
Sept. 28	42	D. Horton, expenses superintendent.....	40 59	40 59
		Art Department.		
Sept. 28	57	F. E. Skeels, expenses superintendent....	51 39	51 39
		Needlework Department.		
Sept. 28	57	F. E. Skeels, board and superintendent....	14 00	
	58	Mrs. F. E. Skeels, services, superintendent	24 02	
				38 02
		Horticultural Department.		
Sept. 28	71	R. D. Graham, expenses supt. and judge....	$34 75	34 75

School Department.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Sept. 28		Frank Maynard, expenses superintendent	$36 81	$ 36 81

Police Department.

Sept. 28	35	E. W. Hardy, superintendent pay roll	500 00	
" 29	66	E. W. Hardy, expenses superintendent	22 20	
				522 20

Gates.

Sept. 28	31	W. P. Custard, pay roll	$203 00	
	135	W. P. Custard, pay roll	5 00	
	138	W. P. Custard, pay roll	2 50	
	44	W. P. Custard, expenses superintendent	21 36	
				231 86

Booths and Privileges.

Sept. 29	76	H. R. Dewey, expenses superintendent	$51 71	
" 28	77	H. R. Dewey, pay roll employes	172 33	
				224 04

Marshal.

Sept. 28	40	H. Whitcomb, assistant marshal	$10 00	10 00

Forage.

Sept. 29	86	H. D. Plumb, straw	139 67	139 67

Postage.

Mar. 22	19	I. H. Butterfield, stamps and envelopes	16 60	
July 31	20	I. H. Butterfield, stamps	79 50	
Aug. 15	22	I. H. Butterfield, stamps	49 60	
Sept. 29	84	Eugene Fifield, stamps	5 00	
	134	Secretary, stamps	6 00	
	91	I. H. Butterfield, stamps	73 00	
Dec. 11	131	I. H. Butterfield, stamps	16 40	
Feb. 21	130	C. W. Young, stamps	11 31	
				257 41

Printing and Stationery.

Sept. 29	74	Powers Tyson Ptg. Co., printing	$215 11	
" 28	80	C. W. Young, tickets	15 55	
" 29	88	Will M. Hine, stationery	10 58	
	115	C. & J. Gregory, tickets	24 50	
Nov. 10	125	C. W. Young, treas., entry and com. books	15 12	
	134	Lawrence & Van Buren	1 40	
Oct. 23	126	Powers, Tyson Co., letter heads and env.	6 75	
Dec. 11	137	I. H. Butterfield, rubber stamps	1 50	
				295 51

Diplomas, Ribbons, Badges.

Sept. 28	67	The Whitehead Hoag Co., badges	$13 02	
" 29	99	Spring & Co., ribbon prem.	36 50	
	134	Stamps for sending and for filing diplomas	8 25	
Nov. 12	127	Calvert Lith. Co., Diplomas	12 50	
Dec. 11	131	Exp. on diplomas, I. H. B. paid	50	
				70 77

Freight, Express, Telegraph, Telephone.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Sept. 29	68	West. Union, tel. bill	$13 25	
	108	I. H. Butterfield, exp. and ft. paid	16 07	
Oct. 1	110	Columbian Transfer Co., bill paid	15 25	
Aug. 14	21	Columbian Transfer Co., cartage 1899	18 75	
Dec. 11	131	I. H. Butterfield, teleph. and telegraph	6 04	
				$69 36

General Expense.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Sept. 21	23	Geo. Steffins, 1899 prem. unpaid	$8 00	
" 28	62	Modern Woodman, per cent receipts Friday	225 00	
" 29	82	Frank Wurzburg, band	156 00	
	86	H. D. Plumb, sundry	10 21	
	104	F. E. Skeels, pay roll, help	52 25	
	111	Foster, Stevens & Co., sundry hardware	6 17	
Oct. 23	123	C. W. Young, treas., Grange prem	100 00	
Nov. 10	124	D. W. Packard, bill paid	34 00	
Feb. 20	133	John A. Hoffman, exp. paid	12 00	
Oct. 1	110	Columbian Transfer Co., storage	6 00	
Sept. 29	107	I. H. Butterfield, messengers at Fair	14 00	
Nov. 10	125	C. W. Young, to pay sundry bills	17 55	
Oct. 23	120	I. H. Butterfield, sundry bills paid	4 00	
Dec. 11	131	I. H. Butterfield, sundry bills paid	12 62	
1901.				
Jan. 14	143	L. J. Rindge, note paid	275 00	
	144	Est. E. C. Bierce, note paid	275 00	
	145	J. E. Rice, note paid	275 00	
	146	Jas. W. Barnett, note paid	275 00	
	147	Henry Spring, note paid	275 00	
				2,032 80

Buildings and Grounds.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Sept. 28	70	West. Mich. Agrl. Society, rent	$800 00	
	46	Mich. Buggy Co., rent of tent	14 00	
	51	Harry Whiteley, rent of tents	100 00	
	81	F. E. Skeels, pay roll, repairs	190 10	
	83	F. E. Skeels, pay roll, help, etc	184 88	
	85	Grand Rapids Awning and Tent Co., rent	33 00	
	89	Chas. A. Coye, rent of tents, etc	327 75	
	93	Voight Herpolsheimer & Co., Dec. Blfgs	151 82	
Oct. 12	113	Harry Hollis, cleaning grounds	40 00	
" 15	114	C. W. Young, treas., to pay sundry bills	45 44	
Nov. 15	128	J. S. Bailey, cleaning	14 25	
" 10	125	C. W. Young, bill paid	5 80	
1901.				
Jan. 14	141	West. Mich. Agrl. Society, bal. rent grounds	9 90	
	142	W. Mich. Agrl. Society, per cent net recepts	1,000 00	
				2,916 94

Attractions.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Sept. 27	28	L. R. Haller, prem. in race	$25 00	
" 28	30	Wagner & Dunham, prem. in race	150 00	
	32	A. M. Gillet, Athletic Troupe	300 00	
	33	L. E. Granger, Horses and dogs	200 00	
	34	Harry La Rose, Spiral Tower	300 00	
	36	Trolly Car Trio act	125 00	
	37	Giant Quartette, music	125 00	
	38	George Beelby, prem. in race	15 00	
Sept. 29	64	M. C. R. R. Transp., Lacrosse Team	71 12	
	78	Harry Hollis, mowing ground	4 50	
	80	Sweet's Hotel, board Lacrosse Team	16 80	
				1,332 42

Advertising.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Sept. 28	50	Evening Press, advertisement	$75 00	
" 29	55	Geo. W. Savage, advt. in papers	143 00	
	63	Grand Rapids Herald adv	75 00	
" 28	67	The Whitehead Hoag Co., buttons	223 86	
" 29	72	Powers, Tyson & Co., lith. posters	535 46	
	75	M. F. Powers, ad in labor program	20 00	
	87	Am. Express Co., exp. on posters	20 96	
	88	Michigan Farmer, ad	23 94	
	94	Calvert Lith. Co., Lith. posters	91 00	
	95	Sanders Pub. Co., ad	11 20	
	96	The Tradesman, ad	14 40	
	99	Spring Dry Goods Co., cambric	8 70	
	100	C. W. Young, treas, to pay posting bills	229 40	
	101	C. W. Young, treas, to pay adv. bills	51 45	
	105	The Democrat, adv	75 00	
Oct. 8	106	I. H. Butterfield, secy., adv bills paid	19 50	
Sept. 29	107	I. H. Butterfield, secy., adv. bills paid	20 00	
	109	I. H. Butterfield, secy., adv. bills paid	136 16	
	112	Mulford & Petrie, banner on street car	10 00	
Oct. 23	117	C. W. Young, treas., to pay bills, adv.	40 73	
	120	I. H. Butterfield, bills adv. paid	13 50	
Nov. 10	125	C. W. Young, treas, bills adv. paid	4 30	
Dec. 11	131	I. H. Butterfield, bills adv paid	18 50	
Sept. 28	80	C. W. Young, bills adv. paid	4 00	
				$1,865 26

Premiums.

Date.	No. of voucher.	To whom and for what drawn.	Amount.	
Dec. 11	132	C. W. Young, order to pay premiums	$6,718 25	
	139	C. W. Young, order to pay premiums	7 00	
				6,725 25
				$22,244 15

SUMMARY.

Winter Meeting	$117 10
Business Committee	351 17
Finance	29 50
President's Office	88 00
Secretary's Office	647 52
Treasurer's Office	448 22
Cattle Department	58 00
Horse Department	46 90
Speed Department	3,317 67
Sheep Department	50 96
Swine Department	32 80
Poultry Department	40 00
Farm and Garden Department	35 36
Dairy, Bees and Honey	50 19
Farm Implement Department	40 71
Vehicle Department	40 59
Art Department	51 39
Needlework Department	38 02
Horticulture Department	34 75
School	36 81
Police	522 20
Gates	231 86
Booths and Privileges	224 04
Marshal	10 00
Forage	139 67
Postage	257 41
Printing and Stationery	290 51
Diplomas, Ribbons, Badges	70 77
Freight, Express, Telegraph, Telephone	69 36
General Expense	2,032 80
Buildings and Grounds	2,916 94
Attractions	1,332 42
Advertising	1,865 26
Premiums	6,725 25
	$22,244 15

The report was accepted and referred to the finance committee.

REPORT OF THE TREASURER.

To the officers and members of the Michigan State Agricultural Society:

Gentlemen—I take pleasure in submitting the following as my report as treasurer of the Society for the year 1900:

RECEIPTS.

From Admissions to Fair	$18,265 40	
" Admissions to Grand Stand	1,797 25	
" Speed Department	1,515 58	
" Privileges sold	2,664 18	
" Privileges sold in 1899, not previously reported	75 00	
" Memberships	479 00	
" Stall rents	172 30	
" Premium returned	17 40	
" Donations from Short Horn Cattle Breeders	160 00	
" Railroad coupons, 1898	489 12	
" Fines, Speed Department	47 35	
" Business order returned	7 95	
" Printing Premium List	140 00	
		$25,830 53

DISBURSEMENTS.

Overdraft, 1899	$41 39	
Business orders, 1900, paid	15,526 90	
Premiums, 1900, paid	6,718 25	
		22,286 54
Balance cash on hand January 15, 1901		$3,543 99

Respectfully,
C. W. YOUNG,
Treasurer.

The report was accepted and referred to the finance committee.

Mr. Bush moved that a committee of seven be appointed by the president, who with the president and secretary shall receive proposals for holding the next fair and report to the executive committee. Carried.

The president appointed as such committee Messrs. Bush, Fifield, Ball, Hinds, Dewey, Custard, Young.

Mr. Ball moved as the sense of the committee that the premium list should not be increased. Carried.

The president appointed premium list committee, Messrs. Boyden, Hardy, Ball, Barnes, Reed, Maynard and McKay.

Committee on rules, Messrs. Fifield, Hinds, Horton.

On motion of Mr. Ball, it was resolved that the Society ask of the legislature an appropriation and that a committee of seven be appointed to present this request to the legislature and endeavor to secure such appropriation.

The president appointed such committee, Messrs. Young, Fifield, Dewey, Graham, Butterfield, Skeels, Hinds.

A recess was taken to 7 o'clock p. m. At 7 o'clock p. m., committee met. The finance committee reported as follows:

To the officers and members of the Michigan State Agricultural Society:

Gentlemen—Your finance committee to whom was referred the accounts of the secretary and treasurer of the Society would report that we have carefully examined the books and vouchers in the secretary's office and have compared the same with the treasurer's report and accounts, and we find the same correct, with the exception of a clerical error of one dollar made in drawing an order.

WILLIAM BALL,
F. E. SKEELS,
JOHN McKAY,
Finance Committee.

The committee on rules reported an amendment to article 5 of by-laws which was adopted.

The premium list committee reported a revised list with some changes from that of 1900, which was adopted.

The bond of the treasurer was fixed at $10,000, and that of the secretary at $1,000, and if a surety company bond the Society to pay the premium on bond.

The salaries of secretary and treasurer were fixed at the sums of $575 and $250 respectively. Adjourned.

The committee on legislation having presented a bill for an appropriation of $5,000 per year for two years to the legislature, the bill was amended and passed as follows:

An act making an appropriation for the Michigan State Agricultural Society for the fiscal years ending June 30, 1902, and June 30, 1903.

The people of the State of Michigan enact:

SECTION 1. That there is hereby appropriated for the use of the Michingan State Agricultural Society for the fiscal year ending June thirty, nineteen hundred two, the sum of forty-five hundred dollars; and for the fiscal year ending June thirty, nineteen hundred three, the sum of forty-five hundred dollars.

SEC. 2. The amounts appropriated by section one of this act are to be used by said society for the payment of premiums to be awarded at the annual fair of nineteen hundred one, and the annual fair of nineteen hundred two, on agricultural, horticultural, manufactured and domestic products, grown or produced in the State of Michigan, said premiums to be awarded under the direction of the executive committee of said society: Provided, That said society shall award and pay the farther sum of four thousand five hundred dollars in premiums at each of the annual fairs in the years above mentioned: Provided further, That forty-five hundred dollars in premiums to be paid by the Michigan State Agricultural Society shall be exclusive of any premiums paid by said society for speed purposes.

SEC. 3. The forty-five hundred dollars appropriated by this act for the fiscal year ending June thirty, nineteen hundred two, shall be paid out of the general fund in the State treasury to the treasurer of the Michigan State Agricultural Society on presentation of a requisition signed by a majority of the executive committee of said society, accompanied by a certificate signed by the president and secretary of said society that the amount of forty-five hundred dollars has been awarded and paid in premiums upon exhibits at the annual fair in nineteen hundred one, exclusive of any premiums paid by said society for speed purposes: Provided, That within thirty days after the payment of the said forty-five hundred dollars by the State, the executive committee shall file vouchers with the Auditor General showing the amount of premiums paid on account of said fair in the year nineteen hundred one: Provided further, That is case the said premiums, exclusive of those paid by said society for speed purposes, shall amount to less than nine thousand dollars, as shown by the vouchers thus filed with the Auditor General, the treasurer of said society shall accompany the vouchers with a draft in such an amount as added to the total payments represented by the vouchers will equal nine thousand dollars: Provided further, That the forty-five thousand dollars appropriated for the fiscal year ending June thirty, nineteen hundred three shall be subject to the same requirements as provided for the appropriation for the fiscal year ending June thirty, nineteen hundred two. No portion of the appropriation for the fiscal year ending June thirty, nineteen hundred three, shall be paid to the treasurer of said Michigan State Agricultural Society, unless the provisions applicable to the appropriation for the fiscal year ending June thirty, nineteen hundred two, shall have been complied with.

SEC. 4. The Auditor General shall incorporate in the State tax for the year nineteen hundred one the sum of forty-five hundred dollars, and for the year nineteen hundred two the sum of forty-five hundred dollars, which, when collected, shall be credited to the general fund to reimburse the same for the money hereby appropriated.

The act having been approved by the governor a meeting of the executive committee was called by the president to meet at the Downey House, Lansing, April 25, 1901.

There were present, the president, vice president, secretary, treasurer and Messrs. Fifield, Barnes, Custard, Ball, Boyden, Jones, Rice, McKay, Hoffman, Hardy, Maynard, Reed, Dewey, Graham, Hinds, Skeels, Horton.

Mr. Young of the committee on legislation reported verbally the result of its work in securing an appropriation.

The committee on location of the fair reported that it had visited Jackson, Kalamazoo, Pontiac and Grand Rapids, and held conferences with citizens of those places. Propositions had been asked for furnishing buildings and grounds complete for holding the fair.

Kalamazoo, Pontiac and Grand Rapids had made verbal propositions.

The report was accepted and the representatives of these places being present were invited to confer with the executive committee, Kalamazoo withdrew its proposition. Pontiac made a proposal to furnish buildings and grounds complete for holding a fair free of all expense if held two years.

Grand Rapids offered to repair and improve the grounds heretofore used and put them in order. The Society to arrange with the West Michigan Agricultural Society as to rental.

On motion an informal ballot was taken for location of fair. The president appointed Mr. Hoffman and Mr. Jones tellers. The vote was:

For Grand Rapids	5
For Pontiac	14
For Kalamazoo	2
Total	21

On motion of Mr. Graham the vote was declared formal and Pontiac declared the place for holding the fair.

The business committee was authorized to contract with representatives of Pontiac for holding the fair at that place for two years.

The election of general superintendent and member of the business committee was taken up. On a vote for general superintendent, Eugene Fifield received 19 votes, scattering 2 votes. Mr. Fifield was declared elected. For member of business committee Mr. Hinds received 16 votes, scattering 5 votes, Mr. Hinds was declared elected. After informal discussion the revision of the premium list to conform with the act passed by the legislature was on motion of Mr. Jones referred to the premium list committee with power.

Mr. Graham and the secretary were added to the premium list committee to act for this purpose.

DATE OF FAIR.

It was moved that the date of the fair for 1901 be the week beginning September 23. This motion withdrawn. It was then moved to hold it the week of the 9th; after discussion this motion amended to hold the week of 23d, and motion carried.

The president appointed the remaining committees and executive superintendents as follows:

STANDING COMMITTEES AND EXECUTIVE SUPERINTENDENTS, 1901.

BUSINESS.

Eugene Fifield, H. H. Hinds and Secretary.

TRANSPORTATION.

H. H. Hinds, S. O. Bush, D. Horton.

PROGRAM.

Eugene Fifield, J. E. Rice and Secretary.

PRINTING AND ADVERTISING.

I. H. Butterfield, Eugene Fifield, H. R. Dewey.

RECEPTION.

S. O. Bush, L. J. Rindge, Wm. Chamberlain.

PREMIUM LIST.

W. E. Boyden, E. W. Hardy, Wm. Ball, L. W. Barnes, F. L. Reed, Frank Maynard, John McKay.

RULES.

Eugene Fifield, H. H. Hinds, D. Horton.

FINANCE.

R. D. Graham, E. W. Jones, John McKay.

GENERAL SUPERINTENDENT.

Eugene Fifield.

CHIEF MARSHAL.

H. H. Hinds.

EXECUTIVE SUPERINTENDENTS.

Cattle—W. E. Boyden.
Horses, Speed—Eugene Fifield.
Horses, Roadster, Draft and Pony Classes—H. H. Hinds.
Sheep—Wm. Ball.
Swine—L. W. Barnes.
Poultry—C. A. Waldron.
Dairy, Bees and Honey—John McKay.
Farm and Garden Products—F. L. Reed.
Vehicles—Dexter Horton.
Agricultural Implements and Machinery—John A. Hoffman.
Supt. Main Building—F. E. Skeels.
Manufactured Goods—F. E. Skeels.
Art—Prof. A. H. Griffith, Detroit Museum of Art.
Needle Work and Children's Work—Mrs. S. Tobin, 94 North Saginaw street, Pontiac.
School Exhibits—Frank Maynard.
Horticulture—R. D. Graham.
Gates—W. P. Custard.
Police—E. W. Hardy.
Forage—John Lessiter.
Concessions and Privileges—H. R. Dewey.
Miscellaneous Exhibits—John McKay.

The president announced the death of Hon. F. Hart Smith, of Somerset, who was an ex-member of the executive committee and who died December 18, 1900, at his home.

On motion a committee of three was appointed, Mr. Chamberlain, Mr. Reed and secretary to prepare suitable resolutions of respect to his memory and that they be made a part of the record.

The committee prepared the following resolutions:

Whereas, The members of the executive committee of the State Agricultural Society, having learned of the death of the Hon. F. Hart Smith, which occurred in the sixty-sixth year of his age at his home in Somerset, Hillsdale county, after a brief illness on the 18th day of December, 1890; and

Whereas, Mr. Smith was a prominent agriculturist of the State, having lived and carried on his large farm in Somerset for over forty years, and was a broad-minded, progressive gentleman, interested in education, and for many years one of the trustees of Hillsdale College, a promoter and active supporter of the Hillsdale County Agricultural Society, besides holding several positions of honor, he was a member of the executive committee of the State Agricultural Society from 1887 to 1895, giving valuable service in the promotion of its interests; therefore,

Resolved, That we as members of this committee desire to express our high appreciation of the service he has rendered the Society, and regret to learn of his death.

Resolved, That a copy of these resolutions be forwarded to his family and also incorporated in the annual report of the Society.

WM. CHAMBERLAIN,
Chairman of Committee.
F. L. REED.
I. H. BUTTERFIELD.

The business committee met at Pontiac, May 15, 1901, and made a contract with the Oakland County Agricultural Society for buildings and grounds to accommodate the State Fair and to hold the fair on the grounds in 1901 and 1902. The buildings and grounds to be furnished free to the State Society.

The premium list committee met at Pontiac, May 1, and revised the list with a view of conforming to the requirements of the act of the legislature appropriating for premiums to be paid to exhibitors of Michigan products only, and decided on the list as published for 1901.

I. H. BUTTERFIELD,
Secretary.

A BRIEF HISTORY OF THE STATE ASSOCIATION OF FARMERS' CLUBS.

The history of mankind from the beginning down to the present time goes to prove that where organization was the most perfect, and in accord with the ends sought there the best results have been obtained.

Successful military achievments have nearly always been attained in the greatest degree in proportion as the central organization was the most complete, and acting in harmony with those co-operating with it. The more thorough the organization in all departments, the better drilled and equipped the soldiers were in all divisions, corps, regiments and down to the corporal's squads acting as one great whole, the greater and more important have been the results. The central organizations of governments, sustained by State organizations acting in unity make this nation invulnerable against the attacks of any foe. The gigantic business operations of the world are conducted mainly by intelligent organization and active co-operation. The principle of centralized power is acknowledged in a thousand different forms. The great success in the religious world is mainly due to organization and agreement in methods. The success attending the secret and benevolent societies all over the world attest its value. By the use of this principle corporate capital is enabled to declare dividends to stockholders. Organization is the power that controls the business world. It enables these colossal institutions to employ experts in every branch of their business. I think it may truthfully be said that nearly all the business of the world, including preaching, teaching, etc., is under the control and direction of organized effort.

If co-operation is so essential to success in legislation, in military operations, in benevolence, in social, religous and literary work, in the successful business operations of the world, it is equally necessary in the business and social life of the farmer.

A full realization of the above and kindred truths led to the call for delegates from the various clubs in the State to assemble in convention for the purpose of organizing a "State Association of Clubs."

The convention was held in the Senate chamber at Lansing, February 1, 1894, with delegates from twenty-two clubs present and gave birth to the Michigan State Association of Farmers' Clubs, the first State Association of Farmers' Clubs to be organized in the world.

The object of the association is quite plainly defined in the preamble to the constitution as adopted at this convention, which is as follows:

"We, the delegates from the various Farmers' Clubs of Michigan in convention assembled, realizing the importance and efficacy of organization in the promotion of ideas and the advancement of measures of general interest and benefit to the agriculturists of this State, believe that the social, moral, intellectual and financial condition of the farmers is advanced by local organization of farmers' clubs, and that the organization of other local clubs will be promoted by a central or State association of clubs already in existence and believe that such an organization would be a valuable means for the interchange of ideas and securing of ends which may be deemed of general benefit to the farmers of this State."

The State Association is no longer an experiment. The good that it has accomplished cannot be estimated. One of the first aims of the association was the formation of new clubs—its aim in this direction has surpassed the expectation of even the most sanguine. Although unable to get in correspondence with all the clubs, there are today over three hundred in the State. However, there should be one in every township in the State, and in the more populous townships more than one.

The principles set forth in the constitution are the advancement of the social, moral, intellectual and financial condition of the farmer. The accomplishment of the first named three has been the inevitable result of good local club work. The number of clubs in Michigan has nearly octupled since the establishment of the State Association, and no one, unprejudiced, will deny this association the credit of being the potent factor in accomplishing this result.

But the formation of many new clubs by which the social, moral and intellectual condition of the members is benefited is not all that the State Association has accomplished.

Another benefit is opportunity of comparing views. No reading or study equals this. Unifying of effort is perhaps the most important benefit, and is of importance when we wish to have our influence or needs felt. We also need it to broaden and round out our characters.

Another result of the State organization is the work in other States. Many states and territories, different places in Canada, even away up in the northwest territory, and out in Australia the organization of Farmers' Clubs is being carried on along lines suggested by our State Association.

In closing this history it might be well to sum up a few of the many things the State Association has done for Michigan.

The number of local clubs has been increased from fifty to over three hundred.

It has increased the club membership from less than four thousand to over thirty thousand.

It has been the means of bringing together annually representative farmers' club workers from every portion of the State for a mutual interchange of ideas.

A unification of effort has been secured among the practical people of the State, in supporting judicious reforms in public affairs.

All the forces desiring good government have been brought together in working order, and have accomplished the end sought through organization.

It has through its declaration of principles at each annual meeting. increased many fold the number of farmers in Michigan who are giving careful and judicious consideration to public matters.

May the good work so nobly begun and so grandly being carried on continue, may every club in the State send its representatives to the annual meeting in December, that the influence of the State Association may be more widespread by the benefit each local club will receive through its delegates.

The association is officered as follows:

OFFICERS.

President—COL. L. H. IVES, Mason.
Vice President—MRS. MARY MARSHALL, South Lyon.
Secretary—MISS JULIA BALL, Hamburg.
Treasurer—MRS. LUCY SWIFT, Flint.

DIRECTORS.

	TERM EXPIRES
W. H. CRAFTS, Jackson	1901
W. F. LEWIS, Vassar	1901
C. E. HADSELL, Troy	1902
J. SESSIONS, Maple Rapids	1902
J. T. DANIELS, Union Home	1903
C. M. FLUMERFELT, Rochester	1903

JULIA BALL,
Secretary.

MICHIGAN STATE GRANGE.

REPORT OF WORK OF THE ORDER OF PATRONS OF HUSBANDRY IN MICHIGAN FOR YEAR ENDING JUNE 30, 1901.

OFFICERS FOR 1901.

Master—G. B. HORTON, Fruit Ridge.
Overseer—N. P. HULL, Dimondale.
Lecturer—MRS. FRANK SAUNDERS, Rockford F. R. D.
Steward—T. E. NILES, Mancelona.
Assistant Steward—WM. ROBERTSON, Fremont.
Chaplain—MARY A. MAYO, Chelsea F. R. D.
Treasurer—E. A. STRONG, Vicksburg.
Secretary—JENNIE BUELL, Ann Arbor.
Gate Keeper—G. A. WHITBECK, Montague.
Ceres—ANNA R. JONES, Lapeer.
Flora—VIRGINIA HALLADAY, Clinton.
Pomona—DELLA PROCTOR, Webberville.
Lady Assistant Steward—MARY ROBERTSON, Fremont.

EXECUTIVE COMMITTEE.

Thomas Mars, Berrien Center	December,	1902
A. E. Palmer, Kalkaska	"	1902
M. T. Cole, Palmyra	"	1902
N. I. Moore, Moscow	"	1902
F. W. Redfern, Maple Rapids	"	1901
E. A. Holden, Lansing	"	1901
F. D. Saunders, Rockford F. R. D.	"	1901

G. B. Horton, Fruit Ridge, Jennie Buell, Ann Arbor, Ex-officio.

In accord with the action of the national body of the Order of Patrons of Husbandry, the Michigan State Grange has advocated and worked during the past year for the following far-reaching objects:

1. Extension of rural free mail delivery.
2. Government control of trusts.
3. The establishment of postal savings banks.
4. Completion of the Nicaragua Canal by the United States.
5. More effectual pure food regulations.
6. Give adequate powers to Interstate Commerce Commission.
7. The election of United Senators by popular vote.
8. Regulating the use of shoddy.

9. Opposed to the ship subsidy bill.

10. Regulating the manufacture and sale of imitation dairy products.

11. Opposed to irrigation of arid western lands at public expense.

The work of the grange in our own State has been carried on along the lines indicated in previous reports. The aim has been to institute several well systematized departments by the use of which the subordinate granges may grow into strong and permanent factors in their various localities. It is now the object of the State organization to perfect these departments and to assist the four hundred and sixty local societies in adapting them to their individual needs.

Toward this end the organizing department has encouraged its deputies to plant strong new granges, to start them well in the uses of the financial arm of the grange and to impress upon them the vital importance of seeking educational benefits through the faithful improvement of the lecture or program hour at each meeting. Sixty-two new local granges have been thus organized.

The lecture, or educational work of the grange has been strengthened by enlarging the monthly State Lecturer's Bulletin and by an increased number of circular and personal letters between the State Lecturer and the lecturers of subordinate granges. The study of the text book on civics has been continued and uniform programs adopted in the majority of granges. The improvement of the country school has been given a large share of attention particularly with reference to introducing nature study into the subjects already taught.

The grange in Michigan has for several years given special attention to urging upon our legislature certain measures of particular interest to farmers. This year the legislature passed two very important laws that represent the result of several years of persistent grange agitation. One was the law prohibiting the coloring of oleomargarine to resemble butter. The law had been urged by the grange for five years, and is believed to be one that the courts will uphold and one of great benefit to consumers as well as to producers of butter. The other law is the one assessing railroad property on the same basis as other property. Some seven years ago the grange began the agitation for tax reform in this State and has made it one of the chief objects in legislative affairs, and the grange looks upon the passage of this law as a triumph for grange principles and methods. The passage of the law granting a one-tenth mill tax to the Agricultural College was also assisted by petitions from granges.

The co-operative department of State Grange continues to thrive on the appreciation and use of the subordinate granges, as the large items of purchases made through the State contracts show.

Under the head of fresh air work for the season of 1900 the State Grange Woman's Work Committee reported 168 children and overworked city women given summer outings in the homes of our members. The following resolution was unanimously adopted by the State Grange:

"Resolved, That we as delegates representing the various granges to which we belong do hereby endorse the grange fresh air work, and that we pledge ourselves to use our best efforts to secure a place in some Patron's home for at least one child or working girl who needs an outing for two weeks some time during the summer months, as best suited to the convenience of the family taking them."

The winter conferences of workers and officers for instruction were continued and plans are now maturing for the extension of more systematic and united effort at the August picnics held in nearly every grange county of the State. Thus the State Grange is endeavoring in various ways to build system within system in order to promote the most economical and effective results possible for the good of the farmer citizen and his family.

JENNIE BUELL,
Secretary of State Grange.

R. C. KEDZIE, D. Sc., LL. D., Father of the Sugar Industry in Michigan.

THE BEET SUGAR INDUSTRY IN MICHIGAN.

THE FAMILY SUGAR BOWL.

R. C. KEDZIE, D. SC., PROFESSOR OF CHEMISTRY AT THE MICHIGAN AGRICULTURAL COLLEGE AND “FATHER OF THE SUGAR INDUSTRY IN MICHIGAN.”

The hope of securing an abundant supply of sugar for the people of our State, derived from sources within our borders and so ample as to fill all mouths with blessing, has been cherished at the Agricultural College for many years.

In my early childhood sugar made a very small part of our daily food. Even “muscovado” was “too rare and good for human nature's daily food” in Lenawee in 1830; and as for “loaf sugar,” that was only for the tea table when “company” smiled on us. Starved for the sweet, I longed for the day when the sugar bowl, filled with blessing and delight should be on every table of rich and poor alike. Muscovado at 12½ cents and loaf sugar at 20 cents a pound were too costly materials for free use by people who often found it difficult to rub one shilling against another. The occasional mouthful of maple sugar seemed only to aggravate the “sugar tooth” instead of satisfying an imperious appetite.

Leaving out of account the meagre supply of maple sugar, our State depended on imported sugar and the amount of money sent abroad year by year in payment for sugar arrested the attention of political economists.

The question then arose whether we may not produce our own sugar, and thus provide a more abundant supply for our own use and at the same time avoid the exportation of a large sum of gold, came more and more prominently before the public. Climatic conditions forbade the thought of attempting the cultivation of the tropical sugar cane in our State. Attention was therefore naturally turned to sorghum or Chinese sugar cane as the most hopeful substitute for sugar cane that could be raised in our State. The old assumption that true sugar can come only from the tropical sugar cane or from plants closely related to it, still held sway over the public mind, while in fact two-thirds of the world's supply came from beets.

SORGHUM AND OTHER PLANTS FOR SUGAR.

Twenty years ago the college undertook investigations on the subject of obtaining a supply of sugar from plants that could be raised in our State. Attention was specially turned to sorghum or Chinese sugar cane as the most promising plant for this purpose, and the variety known as the Minnesota Amber Cane was selected for trial.

SUGAR BOUNTY LAW OF 1881.

One evidence of the interest felt in this subject was the action of our legislature in passing an act [No. 268 of session laws of 1881] to promote the manufacture of sugar, offering a large bounty for the sugar. I quote a part of section 4. There shall be paid from the treasury of the State as bounty to any individual company or corporation upon the report and determination of the Board of Agriculture, as provided for in section 3, the sum of two dollars for every hundred pounds of merchantable sucrose sugar manufactured by said individual, company or corporation in this State, from sugar cane, cornstalks or beets grown therein, and said bounty shall be paid upon each years results for the term of five years from the first day of January, 1882, to all individuals, corporations or companies entitled to the same under this act.

By the same act all buildings or machinery used for the manufacture of sugar from sugar cane, cornstalks or beets were exempt from taxation for five years.

It is thus seen that a bounty of two cents a pound was offered for beet and other sugars manufactured in this State, with additional inducements by exemption from taxation for a period of years. These offers were made twenty years ago, but attracted little attention, only one man applying for the bounty for sugar made from sorghum, and the sum total for his bounties for three years only took $404.70 out of the State treasury. No claim was made for bounty for sugar made from cornstalks or beets.

The college took part in this investigation; purchased 400 pounds of seed of amber cane and distributed packages of the seed to 400 farmers in different parts of the state to determine its value for sugar making and also for stock feeding. An acre was planted with amber cane in 1881, and an acre and a quarter in 1882. Efforts were made to make sugar and sorghum syrup. The sugar making was not successful, as the superintendent of the farm planted broom corn along side the sorghum. The cross-breeding between these closely related plants greatly injured the sorghum as a sugar making plant. The syrup was of good quality, costing thirty cents a gallon.

No attempt was made, or at least no bounty was claimed for sugar made from cornstalks and beets, though the enormous bounty of $2 per hundred pounds and exemption from taxes for five years were offered in the law of 1881.

Why did the two-cent bounty of 1881 do so little to promote the sugar industry in our State while the one-cent bounty of 1897 caused the building of several factories and gave such an impetus to sugar production in our State? The two-cent bounty fell flat, while the one-cent bounty sprang into vigorous life and created a new industry in Michigan. Why this contrast between the effects of the two bounties?

1. The hopes of our people had been centered on sorghum as the sugar plant for our State. As sugar cane had been our reliance in the past, we hoped that the Chinese cane would supply us in the future.

The promising results reached in New Jersey, Illinois and Kansas seemed a good foundation for our expectations for the future. But the sugar making in all these states was abandoned when it was found that sorghum was too variable in its content of crystallizable sugar, the relatively large amount of glucose or invert sugar in the juice preventing the formation of sugar crystals in the sucrose present.

2. Twenty years ago the price for raw or unrefined sugar was eight cents a pound. When the price fell to five cents and refined sugar was sold at six cents a pound, the manufacture of sorghum sugar did not pay.

BEET SUGAR.

Failing to secure the desired results with sorghum the chemical department turned its attention to sugar beets, and in 1890 the board of agriculture anthorized the importation of 800 kilograms (1,760 pounds) of seed of the best varieties of sugar beets for experiments at the college and for distribution among the farmers of our State for trial. The varieties imported were Klein Wanzlebener, Vilmorin Imperial, Austrian Wohanka and White Silesian. These seeds were given out to farmers in all parts of the lower peninsula, with directions for planting, cultivating and harvesting; and a request for reports of the trial and specimens of the beets for analysis. Four hundred farmers received the seeds. Of these 228 reported results and sent beets for analysis. These reports came from 39 counties in our State.

The results of these trials were most gratifying. The average of sugar in the beet exceeded 13 per cent with a purity of the beet juice above 80 per cent. This shows the beets of our State of excellent quality for making sugar, amply justifying the large expenditure required in erecting and equipping a sugar factory. This was just the information that any conservative business man would want before he would consider the question of building a sugar factory. It was the want of such data that prevented capitalists from availing themselves of the bounty law of 1881.

The seed thus sown did not at once spring up into a harvest of factories. It seems to take time for such information to reach the mass of our people, but in 1897 the Dudley bill to promote the sugar industry in our State was introduced in the legislature when the results of this work at the college came into remembrance and seemed to promote the passage of the bill. A committee of the House of Representatives invited me to address the house on this subject.

I complied with the request, and to place the matter in a clear light as related to the growth of beets in different parts of the State, a large chart was suspended in the hall showing by counties (39) the number of experiments in growing sugar beets, the variety of beet, kind of soil, the per cent of sugar and the purity of the juice. At the same time samples of cane, beet and sorghum sugars were exhited, mounted in such way that their physical properties could be directly compared.

The capacity of so many counties in our State to produce sugar beets of high quality for making beet sugar made a strong impression upon our legislators and they passed an act giving a bounty of one cent a pound on all sugar made from beets grown in this State.

The influence of this law was marked. Factory after factory sprang up in our State, producing sugar of great excellence, competing at once with sugars imported from abroad, whether produced from sugar cane or sugar beet. These factories have increased in number till 18 factories in operation or in process of construction show that a new industry has developed in our State. Its benefits are not confined to the factory, but extend to the farm. Unlike lumbering and mining, its blessing overflows and sweetens every field of toil. It is a cash crop and the money in large part flows into the pocket of the farmer instead of being absorbed by some syndicate in Boston or New York. Even the price of common labor is enhanced, wages are not only higher but paid in better form; has changed from dicker to dollars. The boy between 14 and 18, on the uncertain footing between boy and man, drifting toward the pessimistic thought "the world has no use for me," now finds abundant work in caring for this new crop. An instructive lesson may be read by witnessing the behavior of a crowd of juveniles as they receive their weekly pay for weeding beets. Some of the tots are so small that their chin hardly reaches the level of the paying clerk's desk, but each receives his wages and marches off, a capitalist. I quote a notice of such scene in Lansing, July 5.

PAID OFF.

"There was a novel scene at the office of the Lansing Sugar Company Monday evening when for three hours men, women and children waited their turn and then passed to the window and received their pay for weeding beets. Several hundred persons were paid off. At one window the checks given by the foreman were examined and at the next window the envelopes were handed out. A good system for the paying off is employed, and everything went off like clock work. Upwards of $2,000 was paid out. Every Monday the weeders are paid off by these contractors. It is not unusual for a boy not more than 14 years of age to earn $1.25 per day."

One earnest boy as he grasped his week's pay amounting to several dollars, remarked "this will help me to pay my way through college." Some persons lament the degradation of our boys to so menial a work, but the boy with a few dollars in his pocket, earned by his own efforts, is different from the hoodlum in the street. He has thereby taken a long step towards manhood.

THE CAMPAIGN OF 1897.

The interest aroused in the beet sugar industry created a demand in hundreds of communities to know whether their soil and climate would produce sugar beets fit for the factory. This threw a large amount of work upon the Experiment Station of the college. Beet seeds were wanted for trial on hundreds of farms in widely scattered localities, instruction was sought on methods of planting and cultivating the crop and analysis of the beets thus raised to determine the final result.

The department of agriculture contributed a generous amount of beet seed of the best varieties and contributed effectively to the success of the effort. In carrying on the beet sugar campaign of 1897 great

Factory of MICHIGAN SUGAR COMPANY, Bay City, Michigan. The Pioneer Sugar Factory in Michigan.

credit is due to Prof. C. D. Smith, as director of the Experiment Station, who received the seed from Washington, distributed it to the farmers and kept things alive by lectures and papers. Among others who contributed to the success of this great undertaking, honorable mention should be made of Higgins & Lenders, of Saginaw, who made 138 separate trials of raising sugar beets and furnished 138 samples of beets for chemical analysis.

BULLETIN 150.—SUGAR BEETS IN MICHIGAN IN 1897, BY C. D. SMITH, DIRECTOR, AND R. C. KEDZIE, CHEMIST.

The results of the experiments and trials were given to the public in Bulletin 150. It gave the results of analysis of 493 samples of sugar beets, showing an average of more than 16 per cent of sugar in the juice and a coefficient of purity of 83 per cent. The samples came from 64 counties, embracing a large part of the State. A map was printed showing the distribution of these trials by counties with statement of the content of sugar and the purity of the juice. The bulletin also contained a large amount of useful information on the kind of soil, method of planting and cultivating the beets, when to harvest them, etc. The bulletin thus became a text-book on sugar beets in Michigan, and was printed and distributed in the State by thousands of copies.

The work of the college in further promoting this great industry is too recent to be called history; the college is still at work in this line and hopes to be still more useful as the years go by. The fact that nearly a score of sugar factories have been at work or are now in process of construction shows how firmly this new industry has taken root in our State.

WHY DOES THE COLLEGE TAKE SUCH AN INTEREST?

Anything that promotes agriculture is of interest to the Agricultural College. A few considerations will show why the farming class are interested in the sugar beet industry.

1. It is a cash crop and brings money directly upon the farm, and is not controlled by stock-gambling fluctuations in the great cities. The increase of $10 an acre in the price of farm lands in the vicinity of the sugar factory is significant.

2. It diversifies industry, and prevents soil exhaustion if properly managed. Sugar makes no permanent withdrawal of the elements of fertility from the soil—no phosphate, potash, or combined nitrogen. It consists solely of carbon, oxygen and hydrogen—a pure carbohydrate; simply condensed and crystallized wind, water and sunshine.

The exhausting materials are retained in the by-products, the leaves, crown and beet pulp. If these are finally restored to the soil, the exhaustion of the soil is prevented. No amount of pure sugar gathered from a field can lessen its producing capacity.

3. It promotes stock growing and grain raising. The introduction of the beet sugar industry in France raised the average wheat crop from 17 to 28 bushels per acre, and increased the production of fat cattle 50 per cent. In France and Germany the best preparation for a crop of wheat is to raise a crop of sugar beets on the land the year be-

fore. The clean culture and thorough tillage required for a crop of beets explain the benefits.

WHAT OF THE FUTURE FOR BEET SUGAR?

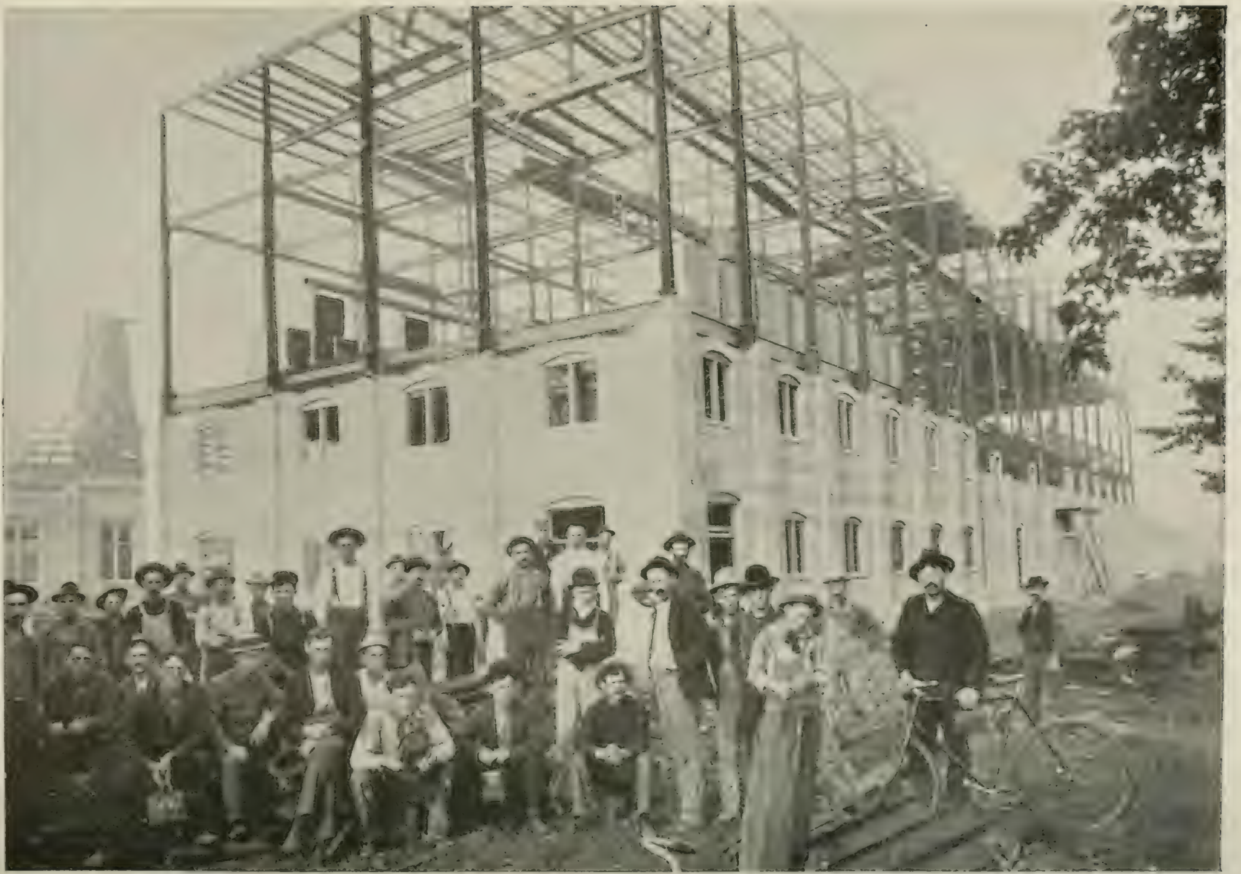
With 13 factories in operation this year and five more in process of preparation for the campaign of 1902, capable of working 9,000 tons of beets a day, with news almost every week of a new factory to be built in the near future, with an investment of nearly $10,000,000 in buildings and equipment, with the farmers alive to the value of this new crop, it would seem that the beet sugar industry was placed on a firm foundation in Michigan. If left undisturbed there is no question about its permanency. There are 20 states interested in sugar production to a greater or less extent in our country.

THE LITTLE CLOUD OF MENACE.

The only danger that seems to threaten this infant industry is the effort to change our tariff so as to permit the importation of raw sugar free of duty. It is already announced that Congress will be asked to remove the duty from raw sugar grown in Cuba and allow its free importation the same as is now done with our insular possessions. If raw sugar is admitted free while a tax is retained on refined sugar, our people will be placed at the mercy of the sugar trust. Casting an eye over the tropical Atlantic one might exclaim with the servant of the ancient prophet, "Behold there ariseth a little cloud out of the sea, like a man's hand," and this cloud, springing over Cuba, fortells a coming storm that may bring financial ruin to sugar growing north and south.

The sugar trust formerly dictated prices for refined sugar in every city and village of our land. But sugar production at home has crippled their power, and threatens to wipe it out. Hence the effort to decry beet sugar and make our people think that cane sugar alone is fit for use. Yet the larger part of the sugar of the sugar trust is made from beet sugar imported from Europe. As Mr. Oxnard forcibly says "the question to be decided is whether the sugar trust or the beet sugar people shall stay in the field." The free importation of raw sugar will close every beet sugar factory east of the Rockies. This battle will be fought out in the next Congress over a revision of tariff on sugar. If the tariff is revised in the interests of the sugar trusts, then the millions of dollars expended for factories and equipments will only be wasted and the new and promising industry, so full of promise to our farmers, will become a byword and reproach. And yet Mr. Havemeyer, president of the sugar trust, coolly announces, "Congress will give us the tariff we want." Willett & Gray's Sugar Trade Journal for August 1, 1901, comes out squarely for free raw sugar from Cuba.

It will be wise for manufacturers, farmers and all who appreciate the prosperity that clusters around every beet sugar factory in our State to begin a political campaign that shall compel Congress to give us a tariff in the interests of our people, ignoring the demands of the sugar trust. Our members of Congress should not be left in doubt about the demands of our people on this subject. The time to inaugurate such a campaign is NOW! and it should end only with VICTORY!



Factory of SAGINAW SUGAR COMPANY, Saginaw, Michigan. In process of construction, 1901.

THE UTILIZATION OF SUGAR FACTORY BY-PRODUCTS.

PROF. C. D. SMITH, DIRECTOR OF MICHIGAN EXPERIMENT STATION.

Beets are carried from the storage sheds to the factory by a current of water which partly washes them. The cleansing is completed before the beets reach the automatic scales. As soon as they are weighed the slicers cut the roots into small triangular shreds of the size of an ordinary lead pencil. These clean, white, shredded beets are conveyed to iron or steel tanks in which they are soaked for an hour, or thereabouts, in warm water to extract the sugar. When the water is drawn off the residue, still white and clean is conveyed to the pulp pile, and is then known as beet pulp.

With the processes to which the juices of the beet are subjected in the manufacture of sugar, we are not at present concerned. To purify the juices, they are treated with lime and carbonic acid gas, which unite in forming carbonate of lime, which is separated in the filter press, giving as a second waste product the lime cakes of the factory.

In most of the modern beet sugar factories the potash is removed from the molasses, by passing the molasses on one side of a thin membrane on the other side of which is clear water. By osmosis, part of the potash goes through the membrane into the water, giving, as a third by-product, this osmosis water.

Finally, after all the sugar possible has been extracted that the process permits, there remains a large amount of molasses containing sugar in a non-crystallizable form, united with potash and various gummy substances. This residual molasses constitutes the fourth by-product of the factory.

It is to the interest alike of the factory owner and the farmer that the best and most economical use possible be made of these waste products. We are to consider their utilization from the farmers' standpoint.

THE BEET PULP.

The quantity of pulp per ton of beets depends, naturally, on the amount of water which the pulp contains. Under average Michigan conditions it may not be far wrong to estimate the weight of the fresh pulp turned out by the factory as fifty-three per cent of the weight of the beets sliced. If, therefore, a factory has a capacity of six hundred tons of beets per day the output of pulp daily will be not far from three hundred and eighteen tons of pulp. If, then, the factory should be in operation one hundred days during the season, the annual product of pulp would be fully thirty-two thousand tons.

Two uses for this tremendous amount of material suggest themselves at once, as manure and as stock feed. Experiments are wanting to furnish data as to the value of the beet pulp as a manure. According to Prof Henry, of Wisconsin, one thousand pounds of this by-product contain but 1.4 pounds of nitrogen, .2 of a pound of phosphoric acid, and .4 of a pound of potash. It is apparent at once, therefore, that if beet pulp has any appreciable value as a fertilizer that value must lie in its ability to form humus, and not in its content of these three most needed elements of fertility. When it is remembered, however, that a ton of pulp, fresh from the factory, seldom contains over two hundred pounds of dry matter, and usually less than one hundred and fifty pounds, it is apparent that it cannot be an important source of fertilizing material for the beet growers about the factory.

The use of beet pulp as stock food is familiar to all European beet growers. Little, if any, of the pulp from German and French factories is allowed to go to waste. The prices of hay, rough forage generally and grain feeds are so high in Europe that the farmers appropriate at once any cheap food offered. In this country, on the other hand, the prices of stock foods are relatively low. Before a new stock food is accepted by the farmer it must demonstrate its right to a place in the ration. It may do this first by its chemical composition, and second by its behavior in feeding experiments.

The analysis of beet pulp and some well known stock foods is given in the next table.

	Water.	Protein.	Crude fiber.	N—Free extract.	Fat.
Beet pulp:					
Fresh	89.95	.927	2.29	6.32	.14
Ensiloed	88.52	1.08	2.80	6.41	.11
Dried	12.58	6.54	18.57	56.29	....
Corn silage	79.1	1.7	6.	11.	.8
Pasture grass	80.	3.5	4.	9.7	.80
Turnip	90.5	1.1	1.2	6.2	.2
Timothy hay	15.	6.	29.6	41.9	3.0
Corn stover	40.5	3.8	19.7	31.5	1.1
Red Clover hay	20.8	12.4	21.9	33.8	4.5

The analysis of the pulp here given is taken from Stohman. Our own analyses of Michigan pulp show that it contains much more water than is here indicated. Upon theoretical grounds, therefore, the objection to pulp as a cattle food is two-fold. A ton of the pulp can scarcely be expected to contain more than two hundred pounds of actual feeding matter, and the cost of carting so much water for so little substance must prohibit the transportation of the material for very long distances. Again, it has been shown by many experiments that taking in an excess of water as must be done where large amounts of pulp are fed hinders fattening rather than advancing it.

As long ago as 1891, Maercker called attention to these defects in fresh and siloed pulp, and showed the advantage of drying the residues both for preservation and for immediate feeding.

A comparison of the composition of the dry matter of beet pulp and some of the other foods named is interesting. It indicates the relative values of the different foods with the water removed.

	Protein.	Crude fiber.	N—Free extract.	Fat.
Beet pulp	9.22	22.79	63.00	1.36
Corn silage	8.1	28.7	52.6	3.82
Turnip	11.7	12.6	65.2	2.00

Beet pulp is practically equivalent to corn silage, therefore, diluted with half its normal weight of water. The silage contains normally twenty-one parts of dry matter per hundred pounds of weight, while the pulp contains scarcely over ten. In both cases the nutritive ratio is about one to seven.

FEEDING EXPERIENCES.

For twelve years in Germany and northern France beet pulp has been used as a factor in the feeding of cattle and sheep. As far as practical results are conecrned it may be said that in the vicinity of the sugar factories practically all of the pulp is consumed, one-third approximately being dried, and the other two-thirds fed either fresh or siloed. The experiments of Dr. Maercker in 1890 were conducted with cattle, milk cows and sheep. He was able to show a profit from the feeding of the pulp, much larger when the pulp was dried than when fed either fresh or fermented. The losses of fermentation are great, amounting to nearly twenty-five per cent of the protein and thirty-seven per cent of the nitrogen free extract. To Michigan farmers this fact has little significance because at present nearly all of the pulp is wasted.

In this country the making of sugar from sugar beets had been continued many years in California before the factories were opened in Michigan. In California, rough forage is relatively expensive, and the pulp has been fed to cattle and sheep with good results. In Utah, near Lehigh, in 1897, a lot of cattle and sheep were put on pulp with hay. The cattle ate about fifteen pounds of hay per day and a hundred pounds of pulp, and the sheep two pounds of hay per day and three to four pounds of pulp. Careful weights were not taken, but the stock gained rapidly, and topped the market when sold in Chicago. At Grand Island and Norfolk in Nebraska a small per cent of the pulp is fed, which gives good satisfaction. Here other feeds are relatively cheap, and the demand for pulp is not intense.

Mr. R. M. Allen, the well-known manager of the Stanard Cattle Company's farms at Ames, Nebraska, fed, in the winter of 1900-1901, thirty thousand sheep on beet pulp. His results are worthy of careful consideration. He reports that the heaviest wether sold, averaged 135 pounds, and the heaviest lambs a hundred pounds. Some individual sheep killed at Ames dressed upwards of 56.8 per cent. The average maximum daily feed was ten pounds of pulp, and Mr. Allen thinks that this is too large for grown sheep, and that seven or eight pounds is rather more than should be fed to lambs. He thinks that next year they will feed even less pulp, not exceeding ten pounds for mature sheep, and seven pounds for lambs. In the next table, taken from the Breeders' Gazette of June 19, 1901, page 1140, is given the results of the work at Ames.

NUMBER AND WEIGHT OF SHEEP SOLD.

	No.	Weight.	Weight of wool.	Total.
Wethers	17,903	2,046,546	54,741	2,101,287
Ewes	3,646	387,350	574	387,924
Lambs	8,528	698,194	39,662	737,856
Total	30,077	3,132,090	94,977	3,227,067

The next table is the average weights, received and sold, and gain.

	Weight when received.	Weight when sold.	Gain.
Wethers	94	117	23
Ewes	85	106	21
Lambs	58	86.5	28.5
All sheep	82	107	25

RESULTS OF SHEARING.

	No.	Wool, lbs.	Average per head, lbs.
Wethers	6,940	54,741	7.88
Ewes	102	574	5.62
Lambs	6,542	39,662	6.06
Total	13,584	94,977	6.99

"The wethers were on feed one hundred and fifty days, the lambs were on feed one hundred and fifty-eight days, the ewes were on feed one hundred and twenty-six days, so the average feeding period of all the sheep was 147 days.

"Here is our sheep feeding account in 1900-1901:

Number of sheep received	31,048	
Number shipped	......	30,077
Sold at Ames	......	35
On hand	......	44
Died	......	892
	31,048	31,048

Per cent of deaths, 2.87.
Total grain fed, 4,775,084 pounds.
Hal fed, 7,871,000 pounds.
Grain, per head, 155 pounds.
Hay, per head, 255.5 pounds.
Average grain per head per day, 1.054.
Average hay per head per day, 1.73 pounds.
Average weight of sheep when sold, 107 pounds.
Average weight of sheep received, 82 pounds.
Average cost per head, $1.7728.
Cost per pound of gain, $0.0709.
Total cast per head per day, 1.2 cents.

"Our feed of grain per day is small, as you see. The feeding period was rather long. The percentage of deaths is too large, principally because of the protracted feeding period. The effect of pulp noted above was not perceived until after the sheep had been a couple of months on feed, and some might prefer to crowd the sheep with grain and pulp and shorten the feeding period. My own preference would be in the case of sheep feeding, in our sheep barn, to feed less than a maximum quantity of pulp and a small feed of grain, with a correspondingly larger feed of sorghum, corn stover, hay, etc., which we cut before feeding, in order to save waste. It is not desirable to make a rule as to this point, as the price of food stuffs and the state of the market may make it desirable to crowd the sheep rapidly, or to protract the feeding period.

"As to the quality of the mutton, I had sheep killed and hung in a cooler for a suitable length of time during the latter part of the feeding period, and found the quality of mutton to be exceedingly fine.

"We have fed pulp to cattle in a limited way, but so far have not had enough for our cattle throughout the feeding period. All the practical men in actual charge of animals on our farm declare beet pulp beneficial to all animals, and this is my own observation. It is good for horses, cattle, sheep or hogs, just as beets are greatly relished by them all."

Turning next to the experience of farmers in our own State, the following statements are quoted as showing opinion of pulp as a feed for dairy cows, and fattening cattle.

Honorable T. F. Marston, of Bay City, fed during the last campaign fifty-five registered Jerseps partly on beet pulp, hauled fresh from the factory each day and fed unfermented. The milk was sold to regular customers in Bay City. The cows had been receiving two feeds per day of corn silage, with hay and grain. The pulp was substituted for one feed of corn silage, the hay and grain remaining the same. No shrinkage in the yield of the herd was noted when the change was made from silage to pulp, nor was there an apparent increase when the change was made back to silage.

Thomas Fitzgerald, near Alma, fed forty-five steers during December, January and February. The ration consisted of fodder corn that would go about thirty-five bushels of ears to the acre and beet pulp. They came out in the spring in good condition. Mr. Fitzgerald also found that his cows gave three to five quarts of milk more when fed pulp than when the pulp was withheld. He fed a hundred ewes nothing but pulp through November and December, while the ewes were running on meadow. They seemed to do as well on the pulp as they did later on drilled corn. The lambs came strong and vigorous, and grew well the following summer.

Mr. Fred Church, of Alma, has fed pulp for two winters. In December of 1899, he was feeding twenty-two head of cattle. He found that the cows did as well in February and March on pulp as they did in June on grass. He was feeding drilled corn, but no hay. He continued the full ration of this roughage when the pulp was added.

Fourteen yearlings were carried through the winter with cornstalks and pulp. The steers came out sleek and in excellent condition in the spring. Mr. Church believes that beet pulp saves one-third of the coarse fodder, while maintaining the stock in good condition and keeping the dairy cows in full flow.

Mr. Byron Nevins, of Alma, has carried twenty-five sheep through the winter on four bundles of fodder daily with two bushels of pulp, and had them do well. The lambs were strong and healthy. To his cows he gave cornstalks, hay and grain as usual, and added daily a bushel and a half of beet pulp each. He is sure that the pulp saved one-half of the coarse fodder, and kept up the flow of milk.

Mr. P. C. Smith, of Bay City, has wintered young stock and fed dairy cows on pulp. He is certain that the pulp not only saves rough fodder, but maintains the milk flow, and keeps the young cattle in better condition than they could be maintained without succulent food.

The pulp at the Alma factory has been entirely consumed. At Bay City but a very small proportion of the total output has been taken away. At Rochester possibly a third of the pulp has been fed. At the other factories the amount carried away is a very small proportion of the total product.

TESTS AT EXPERIMENT STATIONS.

At the Cornell University Experiment Station in New York tests were made with the feeding value of pulp in the winters of 1898-99, and 1899-1900.

In the first experiment the plan was to feed the beet pulp in alternating periods with corn silage, feeding the same amount of pulp daily as of silage. Five cows were used in the experiment.

In the second experiment the cows were fed all the beet pulp they would readily consume, while the amount of hay offered them was the same with beet pulp as with corn silage. The cows consumed from seventy-five to ninety-five pounds per day of the pulp. They were fed eight pounds per day each of a grain mixture composed of two parts of gluten feed, one part sugar corn feed, and one part of wheat bran. The usual records were kept of milk and fat.

A survey of the records show that the cows did quite as well on the beet pulp as they did on the silage. They consumed about equal amounts of dry matter per thousand pounds of live weight, and required nearly the same quantity of dry matter for a hundred pounds of milk and a pound of fat whether the food was silage or pulp. The conclusions drawn from the experiment by the authors are as follows:

"The cows, as a rule, ate beet pulp readily and consumed from fifty to one hundred pounds per day, according to size, in addition to the usual feed of eight pounds of grain, and six to twelve pounds of hay.

"The dry matter in beet pulp proved to be of equal value, pound per pound, with the dry matter in corn silage.

"The milk producing value of beet pulp as it comes from the beet sugar factory is about one-half that of corn silage.

"Beet pulp is especially valuable as a succulent food, and where no other such food is obtainable it may prove of greater comparative value than is given above."

In the winter of 1898 an experiment was undertaken at the Michigan Station with milk cows to test the value of beet pulp in comparison with sugar beets and dry feed. Twelve cows were divided into three groups of four each. After a proper preliminary period there was substituted for the corn silage, with one group beet pulp, with the other sugar beets, while from the third the silage was removed and the loss of dry matter thus entailed supplied by additional hay and grain. All the cows received daily not far from fifteen pounds of hay, ten pounds of bran and five pounds of corn meal. They ate in addition about twenty pounds daily of sugar beets or forty to sixty pounds of the pulp.

Group one was fed five weeks with pulp, then during one week the pulp was gradually removed and for the following five weeks the cows received the same ration of grain and hay as formerly, without the pulp. Group two was fed dry feed for five weeks, then in an intervening week pulp was gradually added, and given for the following five weeks. To group three sugar beets were fed for the entire period of the experiment.

The four cows in group one consumed 4,623 pounds of pulp; 1,675 pounds of hay, and 1,677 pounds of bran and corn. In the five weeks without pulp they ate 1.869 pounds of hay, and 1,868 pounds of grain. In other words, when given no pulp they ate 94 pounds of hay, 127 pounds of bran, and 64 pounds of corn more than when receiving it. This 385 pounds of dry feed may therefore be considered equivalent to the 4,623 pounds of pulp. While receiving pulp the cows gave 3,733.0 pounds of milk, and 128.42 pounds of fat. In the five weeks without pulp they gave 3,386.8 pounds of milk, containing 130.27 pounds of fat.

Group two ate 4,840 pounds of pulp in five weeks, receiving it the second five weeks of the test. With the pulp they ate 1,706 pounds of hay, and an equal amount of bran and corn. In the first five weeks without pulp they ate 1.780 pounds of hay, and an equal amount of bran and corn. The cows ate, therefore in the period without pulp 148 pounds of grain and hay or 74 pounds of hay, 50 pounds of bran and 24 pounds of corn more when not receiving pulp than when it was fed them.

In the first period of five weeks, without pulp, group two gave 3,456.8 pounds of milk and 128 pounds of fat. In the second period, with pulp, the yield was 3,525.6 pounds of milk and 131.25 pounds of fat. Combining the results of the two groups, one of which received the pulp the first five weeks and the other the second, we find that when having the pulp they ate 268 pounds of hay, 177 pounds of bran, and 93 pounds of corn more than they consumed when eating the 9,463 pounds of pulp. The yields on pulp were 7,258.6 pounds of milk and 259.67 pounds of fat; in the periods without pulp the yields were 6,843.6 pounds of milk and 258.27 pounds of fat. As far as fat is concerned, therefore, the yields with pulp and without may be considered indentical. Comparing the feed, then, it might be assumed that the 9,463 pounds of pulp were as effective as the 268 pounds of hay with the 172 pounds of bran and 93 pounds of corn.

A study of the changes in weights of the cows is interesting as bearing upon the influence of the pulp on the body of the cow. Without taking up the cows individually it is enough for the purpose here to record that group one gained 207 pounds in weight on pulp and lost 17 pounds when the pulp was withheld. Group two lost 81 pounds during the five weeks at the beginning of the test, when they had no pulp, and gained 130 pounds in the last five weeks, when they had pulp.

Group three had beets throughout the test. The four cows ate in the first five weeks 2,800 pounds of sugar beets, 1,621 pounds of hay, 1,080 pounds of bran, and 540 pounds of corn. In the second five weeks they ate 2,800 pounds of sugar beets, 1,643 pounds of hay, 1,094 pounds of bran, and 547 pounds of corn. Their yield in the first five weeks was 4,033.3 pounds of milk and 143.95 pounds of fat. In the second five weeks it was 3,646.1 pounds of milk and 135.83 pounds of fat. One cow in the group gained 95 pounds in the first period and lost three in the second, the other thre cows lost 40 pounds in the first period and 11 pounds in the second.

The cows kept in very thrifty condition when fed the pulp, the hair was sleek and the bowels normal.

Before putting the cows on this test they had received a full ration of corn silage, with sufficient hay and grain to balance the ration.

Through the courtesy of Mr. A. W. Wright, of Alma, the station was allowed to weigh certain steers which were being fed on one of his farms, and to make notes on their behavior during a test to compare rations with pulp with the same rations without pulp. Fifty steers were used in the test, which began December 10, and continued three months, or until March 12. Thirty steers were fed pulp with hay, shredded fodder and grain, and twenty a similar ration without the pulp. In the period mentioned the thirty steers made a total gain of 3,880 pounds, or 129.33 pounds per steer, equal to 1.42 pounds per head per day. Without pulp the twenty steers gained 1,245 pounds, 62.25 pounds per steer, or an average per day per head of .68 pounds.

The thirty steers fed pulp consumed in the period 150,745 pounds of pulp, 23,270 pounds of hay, 6,720 pounds of grain, and 10,680 pounds of shredded fodder. The twenty steers without pulp ate 21,015 pounds of hay, 4,480 pounds of grain, and 14,400 pounds of shredded fodder. A comparison of the dail ration per steer is as follows:

	Pulp, lbs.	Hay, lbs.	Grain, lbs.	Shredded fodder, lbs.	Gain, lbs.
With pulp	54.6	8.3	2.4	3.8	1.4
Without pulp	....	11.4	2.4	7.8	.68

For one hundred pounds of gain the amount of feed required with the two pens of steers would be as shown in the next table.

	Pulp. lbs.	Hay. lbs.	Grain. lbs.	Shredded fodder. lbs.
Without pulp	....	1,686.7	359.8	1,156.6
With pulp	3,885	600.	173.2	275.3
Amounts saved by the pulp	....	1.086.7	186.6	881.3

The grain consisted of a mixture of corn and sugar beet seed ground together. No money value, therefore, can be placed upon it. The hay was a fair sample of clover or clover and timothy mixed. The shredded fodder was hardly better than cornstalks and somewhat mouldy. No attempt was made to crowd the steers as the very small grain ration allowed abundantly testifies. It was Mr. Wright's desire to carry the steers through the winter as economically as possible to fatten the following summer on grass.

On the farm of A. M. Todd, at Pearle, Michigan, a similar experiment was carried forward later in the season. In this experiment, as in the other, the steers used were such as could be picked up in the surrounding country, and therefore represented all breeds and combinations of breeds. Twenty of these steers were divided into two lots, ten each, similar in condition and apparent feeding ability.

The pulp used had been hauled from Holland on cars during December to Pearl station and then on wagons two and one-half miles to the farm, where is was preserved in the silo. The steers had been fed pulp for some time prior to the beginning of the experiment.

The weights of the steers, gains and the feed consumed are given in the following table:

	Weight Jan. 21. lbs.	Weight Mar. 4. lbs.	Gain. lbs.	Pulp. lbs.	Hay. lbs.	Bran. lbs.	Corn. lbs.
Fed pulp	9,001	10,224	1,223	13,775	4,470	620	5,350
Without pulp	9,216	10,159	943	....	4,470	620	5,350

Here was a difference in gain of 280 pounds in favor of the ten steers receiving pulp. To offset this gain there was the value of the 13,775 pounds of pulp and the trouble of handling it.

After the fourth of March for three weeks the same steers were kept in the same lot and one change made in the feed. Instead of feeding both lots alike, the lot receiving no pulp was fed all they would eat of the dry feed. The results are given below:

	Weight Mar. 4. lbs.	Weight Mar. 25. lbs.	Gain. lbs.	Pulp. lbs.	Hay. lbs.	Bran. lbs.	Oats. lbs.	Corn. lbs.
Fed pulp	10,224	10,592	368	7,875	1,890	234	562	2,314
Without pulp	10,159	10,376	217	....	2,100	260	625	2,575
Total	....	....	....	....	210	26	63	261

The following table gives the amount required in each case for a hundred pounds of gain.

	Pulp.	Hay.	Bran.	Oats.	Corn.
Without pulp	....	967.7	119.8	288.0	1,186.6
With pulp	2,140	513.6	63.5	152.7	628.8
Total	....	454.1	56.3	135.3	557.8

These results indicate that in this experiment 2,140 pounds of pulp was equal in efficiency to 454.1 pounds of hay, 56.3 pounds of bran, 135.3 pounds of oats, and 557.8 pounds of corn.

Before definite results can be stated or the efficiency of pulp in units of other feeds repeated experiments will have to be made. Enough has been done, however, to demonstrate the truth of the proposition that beet pulp is too valuable a feeding stuff to go to waste and that it has a comparative value sufficient to warrant its transportation to considerable distances, especially where the farmer has no other succulent food. It is the universal experience of those who have fed it that it keeps the animal in splendid condition and adds to the efficiency of the other items in the ration.

THE LIME CAKES.

In the process of extracting sugar from beets it is necessary to clarify the syrups by precipitating various gummy substances with lime and carbonic acid gas. The syrups holding the impurities and lime in suspension are filtered and the residues taken out by the filter from the so called press cakes or lime cakes. These lime cakes have a double interest to the sugar producer. They are liable to contain an excess of sugar which involves a loss to the factory and on the other side they furnish a useful fertilizer to the beet grower. For each hundred pounds of beets sliced there will be approximately ten pounds of this lime cake, which after being washed, should contain but little sugar. They should contain, however, at least one per cent of phosphoric acid and a half per cent of nitrogen. Naturally, the bulk of the material is lime and since in our State many soils are acid and most soils are benefited by lime the use of this by-product of the sugar factory is to be encouraged.

Unfortunately, as they come from the filter presses these cakes are wet and soggy, making it a rather difficult job to get the lime evenly distributed through the soil. If allowed to lie in piles for some months the texture becomes more friable, and the breaking up of the cakes easy.

THE OSMOSIS WATER.

This waste product is valuable solely for the potash which it contains. It may be used by the farmers near the factory in irrigating ditches or spread by other means over the soil to utilize the potash which it contains.

MOLASSES.

A yield of fifteen tons of beets removes from each acre 66 pounds of nitrogen, 30 pounds of phosphoric acid, and 144 pounds of potash. In the sugar factory these minerals appear in the by-products. Part of the nitrogen and most of the phosphoric acid are found in the press cakes, and the potash in the osmosis water and the waste molasses. The molasses contains on the average, nitrogen, 1.46 per cent; phorphoric acid, .05 per cent; and potash, 5.63 per cent.

It is evident at once that this molasses is a valuable fertilizer for the potash and nitrogen which it contains. German farmers have found it a very useful stock feed, either when mixed with the regualr ration or when added to dried blood, dried beet pulp, or even peat and redried. Experiments are not at hand to indicate the value of beet molasses in units of well-known feeding stuffs. All that can be said now is that as the output of the factories increases the farmers must utilize the pulp and molasses as feed for live stock and thus return the valuable plant food removed by the crop of beets to their farms or the soil will rapidly deteriorate. Beets are a trying crop at best, and the only way that the fertility can be at all maintained is by increasing the number of cattle and sheep fed in the vicinity of the factories in the same proportion that the land devoted to beets increases. Commercial fertilizers alone will not maintain the fertility of the soil because they cannot directly supply the humus. On the other hand, the utilization of the by-products of the factory as stock food guarantees the permanence of the fertility of the soil, if indeed it does not insure an increase in richness. In Germany and France statistics show that while the sugar factories have demanded a large acreage for the production of beets they have not lessened, but rather increased, the export of wheat and other cereals from the counties in which they are situated, and have at the same time quadrupled the amount of stock fed, and have thus contributed in two ways to the financial enrichment of the farmers. As the analyses indicate, the molasses contains a very large share of the mineral constituents of the sugar beets. It is therefore important that they be returned to the farmer. On the other hand, molasses is now profitably utilized as a raw material from which alcohol and potash are made. It is now a question whether this waste product is more valuable for the farm or the alcohol factory.

THE AGRICULTURAL STATUS OF THE SUGAR BEET INDUSTRY IN MICHIGAN.

PROFESSOR J. D. TOWAR, AGRICULTURIST OF THE MICHIGAN EXPERIMENT STATION.

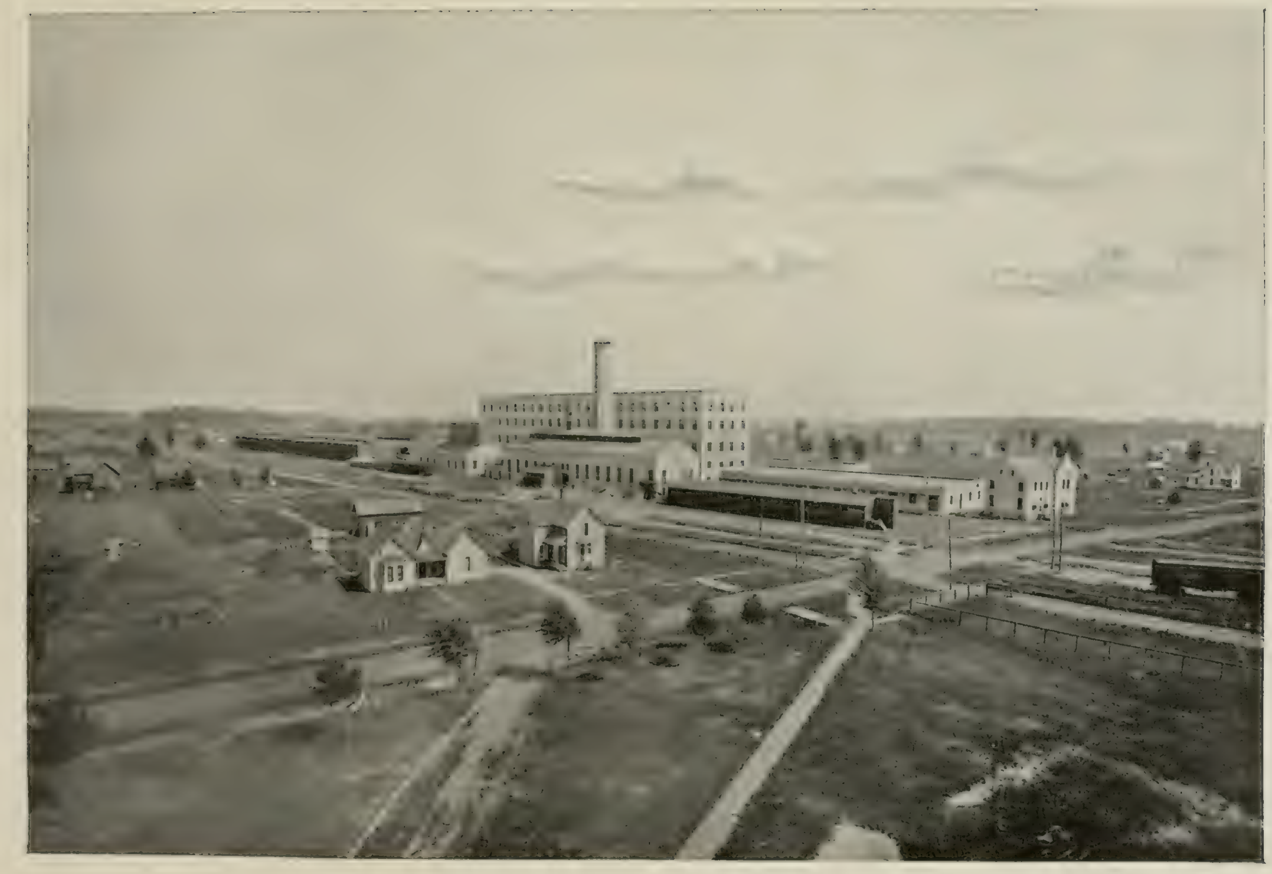
In establishing and conducting a beet sugar plant in a community, an industry is formed that is of universal interest to an extent as great as any modern industry can possibly be. It not only is of extreme great interest to the farmer and the factory, but it brings the farmer and the factory into business relations with the men of every class and industry of the community. The farmer who grows beets for a beet sugar factory must so modify his system and the labor at his command as to be able to concentrate a very large amount of labor in a particular direction during certain portions of the season. To accomplish this he must employ more labor than is commonly found in the rural districts. In the growing of the products to which the ordinary farmer is accustomed there is but one object in view, and that is to grow the largest possible amount of the product, regardless of the quality. In the growing of beets for factory purposes, the quality or percentage of sugar in the beets is a factor in their production of importance equal to that of large tonnage. These two points the securing of labor for the busy periods in the production of the crop and the selection of the soil and management of the crop to produce the highest percentage of sugar, may be mentioned as the two most important points for consideration on the part of the farmers.

It is the practice for the sugar company through their agents to go among farmers previous to the year's campaign and secure written contracts for the growth of the necessary crop for the factory.

The wording of these contracts is such that the farmer is pledged to grow his certain acreage, selling the product to the factory at a stipulated price, determined by the percentage of sugar and purity of the beets. Owing to the fact that numerous swindling agents have traversed the country in the past procuring written contracts from farmers, the average farmer is somewhat averse to signing his name to any paper that will bind him to a thing with which he is not thoroughly familiar. The sugar company invests a large amount of money in the establishing of a sugar plant, and without some security of the production of a crop of beets with which to run the factory no corporation would feel justified in expending its money in the building and equipping such a large institution. It is, therefore, absolutely necessary that the factory know and have in a secure form the exact number of acres that it may depend upon for its season's campaign. The contracts are carefully worded so that no penalty shall be inflicted on the farmer who fails to produce the crop except that the factory retains a certain claim upon it after the beet seed is sown.

THE SEED.

Another clause in the contract is one relating to the seed. Every factory requires its farmers to use the seed furnished by the factory,



Factory of ALMA SUGAR COMPANY, Alma, Michigan.

which in the past has always been supplied to the farmers at a price cheaper than it could be bought of the wholesale seed dealers. It should be understood that the sugar beet seed used in the growing of beets for the manufacture of sugar is a very different article from the beet seed that our farmers have been in the habit of growing, and also from that offered for sale by the large seed dealers. In this connection, as well as in the clause of the contract requiring the number of acres to be grown, no factory could hazard its season's business in growing beets from seed of an unknown and unreliable source. It is barely possible that it will not be necessary for the factories to insert this clause in their contract after the beet growers are educated to the importance of securing only the very best kind of beet seed. The present system, however, guarantees not only to the factory a quality of beets of sufficient sugar content for profitable manufacture but it insures the farmer against the unscrupulous seedsmen who might impose upon him with an inferior quality of seeds. The seed thus far used in this State has all been imported from European seedsmen of established reputations. And while there may be slight differences in the quality of seeds produced by the various European seed growers there has been general satisfaction on the part of our farmers in this connection. It is hoped that the future may see our Michigan farmers producing their own seed, and the process of improvement carried on in the same way that it has been conducted in the past by our French and German neighbors.

THE SOIL.

Before a farmer signs a contract for growing an acreage of sugar beets he should have some idea of the adaptability of his soil for that purpose. Too many farmers who have upon their low muck lands grown in the past enormous crops of roots, have made the mistake of assuming that here would be an ideal place for the growth of sugar beets. While this land will oftentimes yield the largest tonnage, it frequently produces a beet that is profitable neither to the farmer nor the factory. From observations at the Michigan Experiment Station, corroborated by the recorded experiments of other stations, the soil which resembles the loam with a liberal admixture of clay, produces not only the beets highest in sugar content but generally a large tonnage, and always in the combination of tonnage and sugar content, the crop of highest money value. As we depart from the loam by greater admixture of clay we produce beets of inferior quality owing to the fact of their unshapely form. Usually the tonnage in the heavier soils is good, but the quality of the beets is more than correspondingly poor. As we depart from the loam with an excess of sand, we produce beets well up in sugar content but generally lower in tonnage. There is, however, an advantage in employing the lighter soils from the fact that they are much more easily worked, can be worked earlier in the spring and are not rendered unfit for cultivation so long after a rainstorm. Furthermore, the lighter soils do not cling so persistently to the beets at the time of harvesting, and thus reduce the amount of tare at the factory, together with the attendant increased load which is hauled away from the farm. Thus we are forced to advise the soils which are generally classed as loam or clay loam as the best for the production of sugar beets.

There are certain low land soils frequently classed as muck but which are so thoroughly mixed with alluvial soil, or on which the subsoil is very near the surface, where sugar beets will grow, giving a percentage of sugar sufficiently high to be profitable to the farmer as well as the factory. On these soils where such favorable conditions exist sugar beets may be grown, provided the common error of growing beets excessively large is avoided. Wherever the tendency is for beets to grow to an enormous size, say over three pounds each, the remedy is to grow them more closely together. As has been shown by numerous experiments and analyses, beets weighing from one to three pounds give the highest percentage of sugar. Beets even smaller than this show a very satisfactory sugar content, but below the one pound size they are unprofitable to grow, owing to the greater expense in handling after the crop is ready to harvest.

TOOLS.

Fortunately, the expense for tools for growing and handling the sugar beet crop is not excessive. Every well equipped farm is provided with all the tools necessary in preparing the ground. The ordinary grain drill has been used with marked success for sowing the seed, while the cultivation of small areas has been and may be successfully accomplished with such cultivators as are generally found on a farm where mixed husbandry is practiced. In harvesting the crop hundreds of acres are successfully and profitably managed without the expense of special tools. However, for the farmer who is growing any considerable area it will be to his advantage either to purchase or hire the special beet seed drill, the sugar beet cultivator, the beet lifter, and a few inexpensive weeders, hoes and topping knives. The average retail price for a four row beet drill is $40.00; for a four row cultivator, $25.00; for a two row cultivator, $18.00; and for the beet lifters, $10.00 to $13.00 a piece. Many of these tools can be owned in partnership by two or more neighboring farmers, or could be rented at a nominal price. In the older beet-growing districts, however, the practice of each farmer owning all the tools necessary for growing his crop has become quite universal.

PREPARATION OF THE SOIL.

Parallel in importance with the selection of the soil and securing of proper seed is the preparation of the seed bed. Unlike most other crops, the crop preceding the sugar beets has some influence upon the manner of growth of the sugar beet. The crop grown on the ground just prior to the growing of sugar beets should not be one that will leave the ground covered with coarse herbage which would have a tendency to modify the shape of the beets and cut off the soil moisture from below. While beets have been grown successfully on corn stubble and heavy sod with considerable growth of grass, this particular condition is not the best. A wheat or oat or barley stubble, or even clover sod, will give much better results. In the plowing and further preparation of the soil the one thought should be borne in mind that the sugar beet should grow long and straight, and entirely below the surface of the ground. In a soil with a sandy subsoil there is little danger of growing beets objectionable in form. But in soils with a heavy clay subsoil it is impossible to grow properly shaped beets with the maximum amount of sugar and free from elements objectionable to the manfacturer, without resorting to very deep plowing or subsoiling. Whatever the practice may be, the ground should neither be plowed nor subsoiled turning under any considerable amount of coarse herbage late in the season before planting. Where it is necessary to subsoil there are numerous reasons why this operation should be performed in the fall. It will give the ground a chance to settle and overcome the danger of the beets suffering from drouth by reason of excessive porosity, and it will enhance the work in the spring to a very great advantage. If coarse manure is to be applied it should be either plowed under late in the fall or very early in the spring, followed promptly with the roller and harrow, and given sufficient time for the ground to thoroughly settle before the seed is planted. It is much better to apply the stable manure to the preceding crop, thereby getting it more thoroughly incorporated in the soil and supplying all of the necessary conditions for the best possible results. While it is especially desirable to sow the beets as early in the spring as possible, it is equally important that sufficient time be given to the preparation of the soil to furnish for the beets an ideal seed bed. This can only be done by repeated and continuous harrowing with the best kind of implements. There are two ways to overcome the troublesome weeds. First, is by sowing very early, that is, the fifteenth to the twenty-fifth of April, get the thinning all done so that horse cultivation will entirely care for the crop by the time weeds begin to grow at their best. The other method is by delaying the seeding time until near the first of June, and in the meantime give the soil thorough cultivation, such as will allow the weed seed to grow and be very completely killed by the time the beet seed is sown. This latter method requires the most thorough cultivation to subdue the weeds, but this thorough cultivation will more than repay itself in the beneficial results that will follow.

The cultivation should continue up to the day the beet seed is sown, thus giving the beets at least an equal chance with the weeds.

FERTILIZERS.

The exhaustive qualities of the beet crop, together with the question of supplying material for keeping up the fertility of beet fields, are problems already calling for solution. Observations on the growth of crops following the sugar beets indicate clearly that this crop is a severe feeder, and notwithstanding the fact that pure granulated sugar contains none of the lements of soil fertility, the farmer who hauls fifteen tons of sugar beets from an acre of his land removes thereby 66 pounds of nitrogen, 30 pounds of phosphoric acid, and 144 pounds of potash. This is as much in money value of fertilizing material as are contained in 77 bushels of wheat, 105 bushels of corn, 158 bushels of oats, 3.66 tons of timothy hay, or 400 bushels of potatoes. It is furthermore true that it is impossible for every man to return to his farm the equivalent fertilizing material in the form of sugar house refuse

The question then arises what sort of fertilizer shall be employed to maintain the proper supply of plant food. It is found by the experience of practical beet growers that the natural manures produced upon the farm may be applied to the beet crop at a serious disadvantage. It is found that it is particularly desirable to apply the coarse manure some time previous to the time of planting the sugar beet seed. We find, however, that the season previous, even as late as the autumn previous, is a much better time than in the spring prior to seeding. In applying the farm manures to the beet crop, the one precaution should be taken, that is not to apply it in such a form, or at such a time, as to require the beets to grow in the coarse material. The beets will surely grow misshapen and furnish a very low per cent of sugar. If the stable manure is thoroughly rotted, and can be well incorporated in the soil, it may be applied quite near the time of seeding, but if it is coarse it must be applied long enough beforehand to become thoroughly rotted and mixed with the soil.

There are some localities where it has become necessary to depend upon commerical fertilizers for keeping up the soil fertility. Just what fertilizers to apply will depend largely upon the character and condition of the soil, but generally speaking a fertilizer rich in potash and phosphoric acid will produce a higher tonnage and usually beets of better quality. The most satisfactory application made at the Michigan Experiment Station consisted in unleached wood ashes applied at the rate of one ton per acre, sown broadcast on the plowed ground about two weeks before seeding, and thoroughly worked into the soil with a spring tooth harrow. In addition to the wood ashes which supplied a liberal amount of potash, and a moderate amount of phosphoric acid, 110 pounds of nitrate of soda was applied per acre at the time of sowing the seed. Of the commercial fertilizers offered in the market those which are branded root and vegetable fertilizers will probably come nearer the requirements for the sugar beet crop than those for grains. One should look for a comparatively high per cent of phosphoric acid and potash and for the nitrogen which need not be so large in per cent, but it should be in the form of nitric acid, that it may be available to the plant during the early stages of its growth.

SEEDING.

The operation of sowing the beet seed is one of the simplest and most inexpensive of any connected with growing the crop. The special beet drill is to be preferred above all other devices that have been used for this purpose. The ordinary garden drill may be used and has given good results. The most of the grain drills used for seeding on the farm have special devices for sowing sugar beet seed, but as yet we have seen none that are thoroughly satisfactory. In sowing single rows with the hand drill it is difficult to space them at a distance apart accurate enough to admit of cultivation with a two-row cultivator. Whatever style of drill is used, one thing should be borne in mind, and that is to drill at one passing the same number of rows that will be cultivated at a single passing, or that will be taken up entirely by two or more bouts across the field. That is to say, a three-row drill would not be advisable to use where a two-row cultivator were to follow it. The time of seeding is a question of more or less importance, although our results so far give us a range of fully one month when it is equally safe to sow the seed. The earliest seedings, and they may be made in this State as early as April 15, are usually more satisfactory than those at the extreme late end of the season. If the beets under one management can be sown at several different dates there will follow the advantage of a prolonged period for the thinning, cultivation and it would be expected, the harvesting. In this locality it has proven safe to sow as late as the first of June, and occasional seedings later than that have given good results. The tenth to the fifteenth of May, however, would probably be considered an average date for seeding. The question as to the distance apart to make the rows has been under experimentation for a number of years, and still remains in a somewhat unsettled state. It is safe to say, however, that from eighteen to twenty-one inches will be the standard, and that the adherants to the various distances will be subject to individual taste. A depth of three-fourths of an inch has proven the most satisfactory, and drills that can be accurately gauged to an even depth, ranging from one-half to one inch, will be the most popular.

There is, perhaps, no question connected with sugar beet seeding that has commanded more attention than that relating to the quantity of seed. It seems to be a misfortune that such a large quantity of sugar beet seed has to be wasted, for if every seed were planted in the right place, allowing for the usual percentage of germination, two pounds per acre would probably suffice. Yet the experience of those who have grown sugar beets for a great number of years, indicate that not less than fifteen pounds to the acre is a safe limit, while many experienced growers are using twenty, and even twenty-five pounds per acre. So far as our experience has gone, any attempt to economize on the quantity of seed by using less than the regulation fifteen pounds per acre has resulted generally in a financial loss.

About twenty-five or thirty days after seeding, depending entirely upon the weather, comes the most important of all the operations connected with growing the crop. The beets at this time begin to show their fourth leaf, and if properly seeded show a continuous row which must be thinned so that only one beet will stand in each six or eight inches of the row.

While under skillful management a hoe may be used to remove a large number of the surplus beets, each beet must be carefully examined, the best one in every six or eight inches left, and the remaining smaller ones removed by hand. This operation is performed largely by children and women, and is done most profitably by placing a large gang, say fifteen or twenty, under the care of a skillful foreman. Where beet fields are situated near large cities, the problem of securing help for this work is at once solved. There is always plenty of help to be found among the boys and grils, and even women of the laboring classes, who are anxious for this opportunity to go out in the country and earn for a short period the good wages that are paid for this kind of work. Large wagons and omnibusses are loaded with beet thinners every morning, carried out to the beet fields and brought back again at night. Where this kind of labor cannot be obtained the number of acres any farmer can put into sugar beets must be limited to the amount of labor at his command. This thinning operation comes at a period when there is very little time for the labor ordinarly kept on the general farm to be spared from the other work. Furthermore, the operation of thinning the beets should be done with the greatest degree of promptness after the beets are ready to thin, as each day of delay very materially increases the amount of work and ultimate expense of growing the crop.

After the thinning is completed, unless the very best of care has been exercised in preparing the soil, and the land is naturally quite free from weeds, there is still danger of the weeds getting the better of the young beet plants. This requires thorough cultivation with horse tools, and in the majority of the fields one hoeing with hand hoes. With one thorough hoeing, however, after the thinning, there ought to be no further need of hand work in the entire management of the growing crop. Horse cultivation should be kept up as often as once in eight or ten days until the beets have grown so large that it is impossible to cultivate them without injuring the leaves. After this the beets will so completely cover the ground as to require no further attention. There will follow then from six to eight weeks, when a crop will virtually take care of itself, make its greatest growth and develop the larger part of its sugar.

HARVESTING.

This laborious operation, consuming nearly one-fourth of the expense of growing the crop, comes at a time of the year when help is more plenty. The harvesting period can, unlike the former operations, be prolonged from six to eight weeks. The suggestion previously made to plant beets at several different dates will improve the chances for a prolonged period of harvesting. Beets begin to ripen, or rather mature their sugar, shortly after October 1, the exact time depending largely on the season. The indications of maturity are visible on the leaves, which begin to turn yellow. Approaching maturity is more definitely indicated in the analyses of the beets. While the beets are growing the analyses show a very fluctuating per cent of sugar content, frequently a beet will run very high, though the general average is far below the 12 per cent standard.

Mature beets will run more uniform in analysis, remaining somewhere near a standard point. The beets for the most part are lifted by tools made for the purpose, a large number of which, though nearly all built on the same principle, are found in the market. The subsoil plow has been used to advantage, while many ingenious farmers have utilized various tools with special attachments, for this purpose. So far no tool has been successfully built that will do a complete job of topping. This operation is performed by hand, using, preferably, a special knife. After the beets are pulled and topped the vegetable crate is perhaps the most important tool in handling the crop. The further management of the crop is in the hands of the sugar manufacturer.

Interior of Factory of SAGINAW SUGAR COMPANY, in process of construction, 1901.

THE BEET SUGAR COURSE AT MICHIGAN AGRICULTURAL COLLEGE.

F. S. KEDZIE, M. S., ADJUNCT PROFESSOR OF CHEMISTRY AT THE MICHIGAN AGRICULTURAL COLLEGE.

Four years ago when the Michigan Sugar Company started on their first campaign, there were no citizens of Michigan who had sufficient knowledge of the processes of manufacture of sugar from beets to be of and assistance, except as general helpers. At that time all the work involving the chemical control of the factory process and the testing of the beets as received at the sheds had to be done by men with previous experience, obtained outside of Michigan either in Europe, in the beet sugar course given by the Nebraska State University, or learned in some factory, usually from some person with strong foreign accent and a decided aversion to teaching a Yankee anything about the business. It seemed obvious that the new industry should give employment to Michigan young men, and that here at the Michigan Agricultural College, a brief course, covering the main features of the factory process and its chemical control, would be of interest and profitable to those of our students who desired to take it.

In the spring term of 1899, Mr. J. V. Wolf, Jr., chemist of the Michigan Sugar Company (a graduate of the Nebraska State University and Sugar School) gave a four weeks course on the chemistry of beet sugar manufacture to 15 of our junior and senior students. Four of this number had employment during the campaign that year, two at Alma, one each at Bay City and Rochester.

It was apparent from the beginning that the instruction necessary to impart a useful knowledge of the subject could not be given in so short a time. So the following year, January 1, 1900, a three months course was inaugurated. In addition to the chemistry of sugar manufacture, instruction was given in the production of the crop, Professors Smith and Towar giving lectures on proper selection of soils, preparation of the seed bed, fertilizers, thinning, weeding and cultivation of the beets. These lectures were supplemented by field work done by each student.

Professor Wheeler in a course of lectures discussed the botanical origin and history of the sugar beet, and the fungus diseases which attack the beet plant. This course was supplemented by laboratory work in testing beet seed for purity and vitality. In this manner each student learned how to determine which of two samples of seed showed greatest germinative strength. The chemical instruction and the instruction in the work of the factory, which constituted the largest proportion of the work, was given by Mr. Alfred N. Clark, who having had factory experience, and being a competent chemist and engineer, was well prepared to make the details of the process and the chemical control clear to the students. During the campaign following (1900), we had eleven men from our school working in Michigan factories. The next year, from many young men, who had gone into factory work as helpers, came applications to enter the sugar school. Many of these men had but a very slight knowledge of the chemistry of the process by which sugar is extracted, and in order to understand it and be of better service and capable of filling better positions in the work of the factory these men needed more time than our regular college students, who had taken the full course in chemistry.

To meet the demand of this class of men, we lengthened the course to six months, beginning January 1, 1901 and continuing it to July 1. Eighteen men completed the work and all of them are now employed in Michigan factories, filling positions as beet testers, assistant chemists, etc.

The work of chemical instruction in the school is purely elementary. Its aim is to make clear a knowledge of the process by which sugar is obtained from beet juice. The student also is taught how the various steps in the process are controlled by chemical analysis. He makes these analyses himself and thus learns how the factory superintendent is guided in his work, and can therefore render to him more intelligent assistance. The object we seek to attain by our course of instruction is two fold, viz., to give Michigan young men an opportunity to work into the business understandingly, and to help the manufacturer by supplying him with intelligent trained men.

The efforts of the College to train this class of men has been fully appreciated by Michigan sugar factory managers. There is a demand for more men this year than we can supply and it seems plain that if all the factories now projected for next year are completed and put in operation the call for trained men will be still more urgent.

HOW THE BEET SUGAR INDUSTRY IS GROWING.

BY RAY STANNARD BAKER, M. A. C., CLASS '89.

[From Review of Reviews, March 1901, by permission.]

"The Evolution of Human Diet" is one of the fascinating books that is yet to be written. When it does appear it will contain much that is curiously interesting about sugar and how it has invaded the world's pantry. A chapter on this subject might well be given the title, "Sugar vs. Pork." It seems odd to link together such foods as sugar and pork, and yet the more sugar man eats the less pork he needs, each serving the same purpose in the human system, that of fuel to supply heat and energy. Fifty years ago sugar was a rare luxury, of poor quality and high price; our grandfathers obtained the heat and energy which their bodies required largely from pork and other fats. Then sugar grew cheaper, it was a vegetable product pleasant to the palate, easily kept and pure in quality, and the consumption of it grew in enormous proportions, no doubt cutting heavily into the pork industry. Today it has become a table necessity, and the amount of it eaten every year is increasing at a rate out of all proportion to other foods. Next to the English the Americans are the greatest of all consumers of sugar, and the total of our purchases yearly is far greater than that of any other nation. We eat over 2,000,000 tons a year, or nearly 63 pounds of every man, woman, and child in the country. That means one and one-fifth pounds a week. Twenty years ago the consumption was only 38 pounds annually for every person—certainly a striking evidence of the growing use of sugar. It is said that the Americans are the greatest eaters of sugar in the world. The English consume a greater quantity—over 86 pounds per capita—but much of it goes into fine marmalades, jellies, and so on for exportation purposes. After the Americans, the Danish and Swiss are the greatest sugar eaters, and then in order come the Dutch, the French (with 30 pounds a year for each person), the Germans, and the Swedes. The southern peoples of Europe, the Italians, Spanish, Grecians, and others are very light consumers of sugar, partly because they have not the wealth of the northern nations, and partly because they live in a warm climate where they do not need heat-producing foods. Generally speaking, sugar is one of the indices of national progressiveness; the more enterprising and energetic a people, the more sugar they eat.

Sugar has not risen to its present prominence among commodities without working great changes in agricultural conditions, even to the extent of causing wars, for commercial economists show that the Spanish-American war grew directly out of the conflict for supremacy between the sugar beet growers of Germany and the cane sugar growers of Cuba, Porto Rico and the Philippines. The wonderful success of science and brains applied to sugar production in Europe enabled the Germans to undersell the Cubans, thereby causing the discontent and hardship which finally led to the Cuban insurrection against Spain and the subsequent interference of the United States. Cane sugar and beet sugar are exactly the same in composition, in appearance, and in taste, but the struggle between the growers of these two great sources of production has not yet seen its conclusion. A comparatively few years ago beet sugar was almost unknown; the world's sweets came entirely from the cane, and the semi-tropical countries where cane grew most luxuriantly earned all the profits of the industry. Today, more than half of the world's sugar is made from beets. The northern races have again outstripped the southern races. It is probable that many Americans, thinking they are using sugar from the cane of Cuba and Louisiana, are in reality eating sugar from the beets of Germany, or California, or Michigan.

WHY DO WE IMPORT SUGAR?

Sugar is one of the few great commodities in the production of which the United States is weak and dependent. In almost all of the great necessaries of life—food, clothing, fuel, and shelter—the country is more than self-supporting, but in the matter of sugar we are largely dependent on foreign supplies. And our sugar bill is the largest by far of any of our foreign accounts—twice that of coffee, which stands next in prominence, and much greater than that for india rubber, tea, silk or hemp. Every year we pay about $100,000,000, or $1.35 for every man, woman and child in the country, to foreign countries for sugar. Indeed, out of more than 2,000,000 tons of sugar which the United States consumes annually we produce a paltry 270,000 tons, mostly from the cane fields of Louisiana. This does not include the production of the new island possessions, Porto Rico, Hawaii, and the Philippines; but these would add only 460,000 tons to our production, still leaving us to obtain much more than half of our sugar from the foreigner. And all this in the face of the fact that so good an authority as Secretary Wilson of the Department of Agriculture says:

"We have no more need to import sugar than to import wheat."

Secretary Wilson spoke from a thorough knowledge of the remarkable strides made during the past two or three years by the sugar beet industry in this country. The American farmer has suddenly discovered that he can raise with large profit as good sugar beets as there are in the world, and the American manufacturer has learned that he can make those beets yield the highest grade of pure sugar. Twelve years ago the total production of beet sugar in America was 255 tons; six years later the production had jumped to 16,000 tons, and last year (1899) the production was about 80,000 tons. For 1900 those who know predict a production exceeding 150,000 tons, nearly doubling the output of a year ago and making the beet sugar yield of the country nearly equal to the cane sugar yield. And thus, out of almost nothing, the United States has built a sugar industry in half a dozen years, the output of which this year will be about double that of the island of Porto Rico. And the work has barely begun. In 1898, Michigan had one sugar beet factory; two years later in 1900 she had ten factories. In California the largest beet sugar factory in the world has just been completed, larger than anything in Europe, although Germany has been years at the business. This enormous factory cost $2,750,000, and it will turn out upward of 400 tons of sugar every day, using 3,000 tons of beets for the purpose and consuming yearly the product of 30,000 acres of land. Capital is always shy about venturing into new industries, but it has taken beet sugar making to its heart. Indeed, one who reads of the growth of the industry in Illinois, Nebraska, Colorado, New York, Iowa, Minnesota, New Mexico, and other states can hardly resist the contagion of the beet sugar enthusiasm. At the rate at which the industry is now growing, it will be only a few years before the United States will supply her own sugar needs, great as they are, thereby keeping at home the large profits of growing the beets and manufacturing the sugar, and saving the expense of shipping the sugar hundreds or thousands of miles.

ENCOURAGEMENT FROM WASHINGTON.

Sugar beet growing is typically a new industry, born of scientific investigation and intelligent governmental encouragement. In the first place, the sugar beet is nothing more than the ordinary garden-beet, bred and developed by years of careful selection until it produces a very large percentage of sugar. To the Germans belongs the credit for working out this development, and for beginning the manufacture of sugar from beets. Their success encouraged other nations in Europe to take up the industry, and more recently it obtained a foothold in California. But it was not until the United State Department of Agriculture began a campaign of systematic sugar beet education and experimentation that the industry showed sign of spreading widely over America. It required faith and perseverance to induce men of capital to venture upon an unknown industry, the profits of which, uncertain enough in themselves, were dependent on the efforts of farmers who never had grown sugar beets, and who were reluctant about undertaking a doubtful new crop which cost much more money and labor to grow than any other common crop.

Fortunately, however, the agitation was begun just at the close of hard times in 1897, when the farmer was discontented and willing to try new things. At the same time capital, which had been timidly withholding from investment until times were better, was eager to investigate new and promising chances, such as the sugar factory industry might afford. The government in 1897 imported from Europe a large quantity of sugar beet seed, and distributed it free among the farmers of various states, upon condition that beets should be grown and samples sent for examination. When the samples came in the analysis showed that many were very rich in sugar, much richer than the ordinary crops of Europe, especially favorable results being obtained from the Pacific Coast states, from Colorado, and from the great central states of Michigan, Wisconsin, Iowa, Nebraska and Illinois. Other states also showed excellent results. Interest was everywhere awakened and some of the states, through their agricultural colleges and experiment stations, took up the work of promotion vigorously, and in several cases a bounty was offered by the legislature for all beet sugar produced. In Michigan, Dr. R. C. Kedzie, chemist of the Agricultural College, and Prof. C. D. Smith, director of the Agricultural Experiment Station, wrote bulletins, made speeches to farmers, talked with capitalists, visited the beet fields, indeed, made a business of assisting the new industry. As a result, Michigan built ten factories in two years, and the cheapest of them did not cost less than $300,000, and several of them cost very much more. Other states were only a step behind. Certainly, there never was more conclusive proof of the value of intelligent scientific and educational effort in building up a new industry. The work of the Department of Agriculture and of the Experiment Station and the Agricultural College in the single State of Michigan has thus added, by conservative estimate, from 20 to 50 per cent to the value of the lands suitable for beet growing in the vicinity of many of the factories, and it has created a new source of employment for a large number of working men and women.

SOME RESULTS IN MICHIGAN.

Recently I visited some of the beet fields of Michigan in company with Dr. Kedzie and was shown through the pioneer factory of the State at Bay City. There are three factories here within a radius of two miles, and there is no better chance anywhere to see the new industry at its best. In fact, sugar beet growing and sugar making have appeared as the salvation of that part of the State. Fortunes were once made in central Michigan from the pine timber industry, but the forest lands are now practically denuded, and the great sawmills, one after another, have been closing, leaving no other great industry to take the place which they filled. Capital had accumulated, and being driven from the old channels of activity, took up with avidity the manufacturing of beet sugar. Nor is this a merely local condition; in many parts of the United States sugar beet raising has appeared as the salvation of a failing community.

Here around Bay City the land is flat and rich. It is settled largely by Hollanders, with a liberal admixture of Americans of other origin. The farms are small and thoroughly tilled, and when the farmers were first approached by the representatives of the sugar factories they showed much more than ordinary willingness to take up the experiment of sugar beet raising. This enterprise on the part of the farmers is the more surprising, because sugar beet culture represents an entirely different kind of farming from that usually practised in America, a more careful or intensive farming as distinguished from the extensive farming practised by the producers of corn, wheat and hay. It more nearly approximates the system in vogue in Europe, bordering, as it does, on gardening. By the old system a farmer planted a field of wheat and paid no more attention to it until it was ready to harvest. But when beets are planted they require constant and costly attention during many months. In the first place, the ground must be much more thoroughly prepared, plowed deeper, and more carefully pulverized than for any other crop; then the seeds must be sown with care in drills, and when they come up, the plants must be thinned out to give room for the beets to grow—work that requires the painful labor of knees and back during the long, hot days of June. Weeds must also be kept down with perseverance, and cultivation must go on steadily until the leaves of the beets are large enough to shade the ground. All this costs immense labor, and care, and expense, especially if the fields are large. The farmer cannot depend on his own family to do all the work, but must hire boys, and women, and sometimes men, to help with the thinning and weeding. In short, it is a much more scientific method of farming than that ordinarily in vogue in this country; it uses the land more thoroughly and profitably, and it requires much more business capacity on the part of the farmer. But if it costs more to raise beets per acre than wheat or corn, the profits are correspondingly much greater, and as soon as the farmer can be made to see this great advantage, he is usually more than anxious to take up the work. The Bay City factory already mentioned, in common with many other factories throughout the country, employs a man whose sole duty it is to go through the country and interest the farmers in beet raising, showing them how the work is done, making contracts with them, and then watching the crop the whole season, giving his advice and assistance wherever possible. At the time of my visit at Bay City the beets were just ready for harvest and the great flat fields of them covered with spreading green leaves, furnished an example of farm wealth to be equaled in few other places in the country. The sizes of the crops of various farmers varied from two or three acres up to 180 acres, all planted to beets. Every acre of these splendid farms will yield from

12 to 20 tons of beets, and the value per ton is from $4 upward, according to the richness of the beets in sugar. Say that the yield is 15 tons per acre and that the farmer receives the minimum of price for his product, his income would then be $60 per acre, very much more than any other farm crop would yield.

In order to show what was being done by these farmers, I obtained from Prof. C. D. Smith a number of actual instances of profits made in raising sugar beets, the year being 1898.

Name.	Acres.	Yield, tons per acre.	Cost per acre for raising.	Receipt per acre.	Profits per acre.
G. Hine	24	13.1	$41 25	$64 59	$23 34
S. F. Sayles	4	17.5	46 30	67 52	21 22
J. F. Boes	1	18.8	32 02	89 09	57 08
Thomas Handy	16	12	31 63	57 34	25 71
C. B. Chatfield	13	14.5	38 82	65 25	26 43
J. W. McIntosh	8	17.5	35 15	66 75	31 60

With such profits as these, dollar wheat, as one of the Bay City farmers expressed it, "ain't no whar'." It is a good crop of wheat that yields a profit of $5 an acre.

THE BEET AS A FERTILIZING AGENT.

Nor are the great profits the only advantage which accrues to the farmer from beet raising. The thorough working of the soil necessary to the production of a good beet crop leaves it in superb condition for a crop of wheat or corn during the following year, thus adding a new and valuable element to the system of crop rotation. Moreover, the leafy tops and the crowns of the beets, which are cut off, can be fed to stock, or left to fertilize the fields, and the pulp which is thrown out from the factory after the saccharine juice has been extracted, also makes a most valuable cattle food. For the peresent the Bay City factories give away this pulp free to the farmers, the idea being to teach them its excellence for stock feeding purposes, but in many other states it is sold at a good profit. In Germany this pulp is an important article of commerce, and not a pound of it goes to waste. It will be seen, therefore, that the beet is very thoroughly worked up and saved, and that the crop may be made to return to the farm practically as much fertility as it takes away. Of no other crop can this be said. In shipping sugar from the country no important element of soil fertility is lost, sugar being, as Dr. Kedzie expresses it, "condensed sunshine, wind, and water," composed wholly of carbon, hydrogen, and oxygen. In shipping wheat from the country, on the other hand, the farmer ships the very life of the soil—the nitrogenous and phosphatic matter. The grain raisers of the United States do not fully appreciate this fact as yet, because their land is new and rich; but in Europe, where the fertilizer question is of burning importance, the question is given its due weight. No less accomplished a student of the sugar question than H. W. Wiley, chemist of the Department of Agriculture, calls beet growing "the salvation of American agriculture."

THE CASH PROCEEDS TO THE COMMUNITY.

The greatest difficulty experienced by the farmers in every part of the country where the new industry is being inaugurated, is to find enough workmen during the busy season to thin and weed the beets. In Europe this question is solved by the cheap labor of women, and to some extent the same class of help is employed in the fields around Bay City, women of foreign birth being hired from the cities of Saginaw and Bay City. Boys are also largely employed at wages as high as $1 a day and dinner. (In Nebraska single families have made $160 or more a month working in the beet fields.) All this has tended to make the poorer classes of the two towns exceedingly prosperous. Indeed, the beet sugar industry is contributing wealth to the Bay City region in a manner quite unexampled, except in other neighborhoods where the new industry is equally prosperous. This year (1900) the three factories will pay in cash for beets something more than $400,000 to the farmers within a radius of 25 miles of Bay City. Certain it is that the farmers in that part of the State never before saw such a cash income as this.

THE MANUFACTURING PROCESS.

As soon as the beets are harvested, in September, the factories notify the various farmers, and a certain number of loads are brought in every day and dumped into the great reserve bins, adjoining the factory. They are weighed with great care, and a sample is taken from each load to be analyzed, payment being made on the basis of the amount of sugar which the beets contain and the percentage of its purity. All this requires an extended and intricate system of laboratory analysis and the most methodical bookkeeping, so that every farmer shall have justice done to him. Indeed, the whole process of manufacturing sugar from beets is complex and costly.

I shall not attempt here to give a detailed description of these manufacturing processes; that would require too much space, but in brief they consist in first thoroughly cleaning the beets and then in slicing them into thin pieces, after which warm water is employed to dissolve out the sugar. The juice thus produced is clarified with lime, then concentrated, then evaporated, and finally crystallized. In about twelve hours from the time that the raw beets enter the factory to be sliced, the pure, white-grained sugar comes from the crystallizers ready to be barreled for market. In making cane sugar, the factories on the ground usually produce only the raw sugar, and this is purchased and refined by the great sugar companies of New York and elsewhere. This work of refining at a point far distant from the place of production has enabled what is known as the "sugar trust" to control in large measure the output of fine granulated sugar. But the advent of the beet sugar industry, with every factory producing the very best grades of white sugar directly from the beets, may play an important part in placing sugar again among those commodities the prices of which are regulated solely by the law of supply and demand. The "sugar trust," therefore, looks with small favor on the new industry.

A sugar factory requires large quantities of pure limestone for use in clarification, plenty of pure water, and coal for fuel, and the success of the factory is governed to a considerable extent by the abundance and cheapness of these three requirements. The factories of Michigan are very fortunately provided in regard to all of these particulars; coal is especially cheap, the mines being located only a few miles from the factories.

In the production of sugar there is a large by-product of molasses, some of which is saved and used for further sugar production. Eventually, however, all this molasses will be saved, either by mixing it with the pulp to make a fine grade of cattle food, or else it will be used for producing alcohol, as in Germany. A factory with a capacity of 750 tons of beets a day, a little larger than that of the ordinary factory, but not so large as some of those in the west, will produce 80 tons of pure granulated sugar daily.

One feature of the new enterprise is the part which American engineers and machinists have taken in the work. One would suppose that American promoters of such a new industry would have been compelled to import all their machinery from Europe, where the business of building factories has been long established; but such is not the case. Not only has American ingenuity risen to the occasion, but the work has been done so well that our machinery is actually more effective than that in use in Europe. One factory in Michigan which was originally fitted with German machinery has had to be entirely rebuilt, with the substitution of American-made machinery at a cost exceeding $200,000.

One thing, however, the American lacks. He has not yet learned how to grow seeds of sufficiently high grade for successful beet sugar production. Consequently, all seed must be imported at considerable expense and with great care and caution from France and Germany. One of the Bay City factories imports seed in large quantities and sells it to farmers who carry its beet growing contracts, thereby assuring a production of beets of a high sugar value. But the American farmer will not long suffer from this difficulty, because extensive experiments are going on in various parts of the country which have for their object the production of high-grade seed.

In spite, however, of the growth of the new industry, it plays as yet only a small part in supplying the sugar consumption of the country. I was much impressed by a remark of the owner of the Bay City factory which I visited. He said: "Last year we produced about 6,000,000 pounds of sugar. If we had produced 1,500,00 pounds more, we should have been able to supply the sugar requirements of Bay and Saginaw counties"—two counties out of a great State. Nothing could better show the vast sugar needs of the nation.

THE DISCUSSION ON THE BEET SUGAR INDUSTRY IN MICHIGAN BROUGHT DOWN TO DATE.

Secretary Bird has invited me to contribute an article on our sugar beet industry, bringing the discussion down to the opening of the beet sugar campaign of 1901. The subject is so important to our people and the interests involved are so wide reaching, that I have consented to contribute what I could to the satisfactory solution of this industrial question. It seems to me that the fairest way to close this subject for the time would be to quote the articles that have been published in the public press, and the replies that have appeared in opposition. I make no apology therefore for placing these articles in a body before the public. A strong effort will be made in the near future by forced competition, by legislation and other means, to crush a promising industry, and the public need to be awake to the danger which threatens them.

BENEFITS THE FARMER THE MOST.

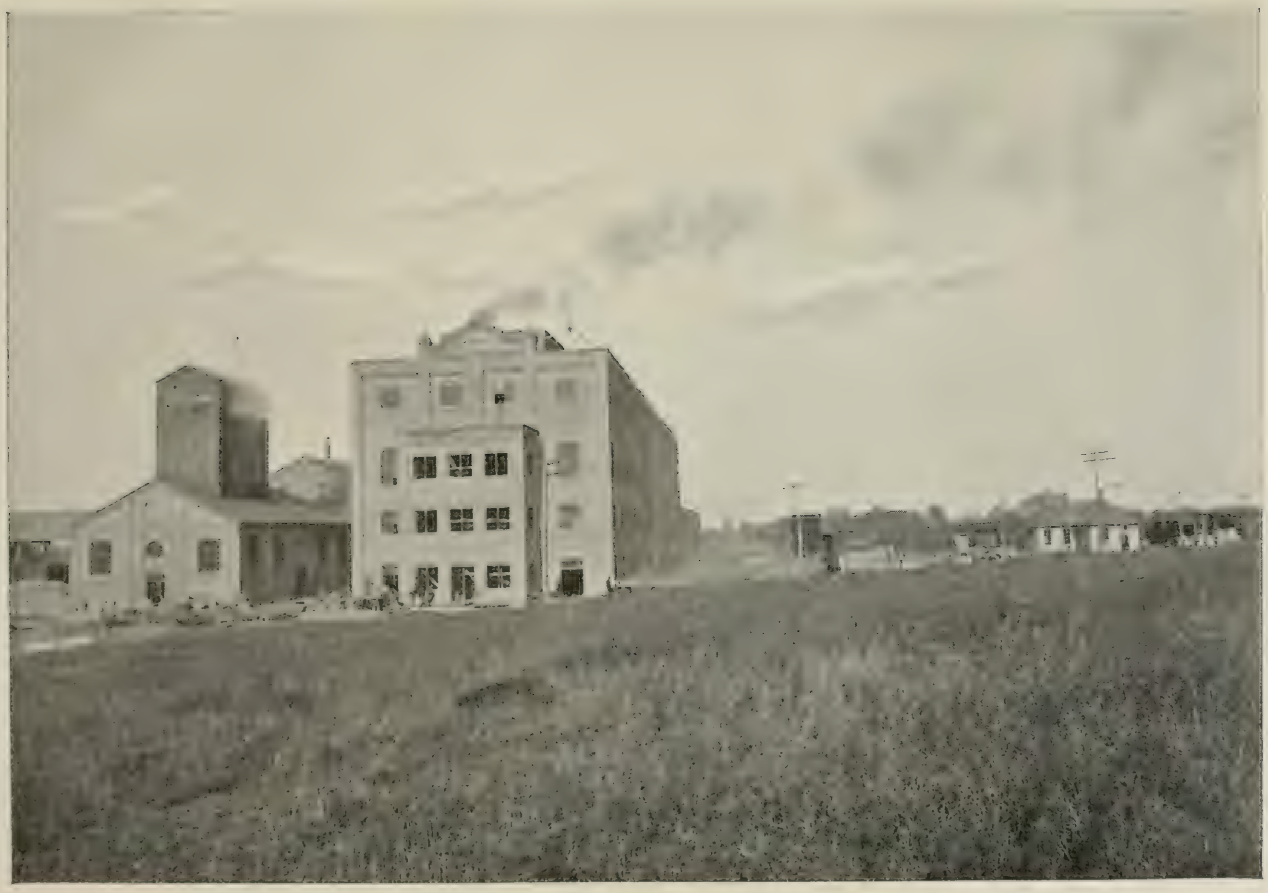
[From Detroit Free Press, Oct. 11, 1901.]

IMPOSSIBLE TO FORM TRUST IN THIS BUSINESS.—GROWER IS THE KEYSTONE IN THE SACCHARINE STRUCTURE.—REFINERS MAKING DESPERATE EFFORTS TO TOPPLE IT, MAINLY BECAUSE MICHIGAN PRODUCT GOES DIRECT TO THE CONSUMER.

ANALYSIS OF BEET SUGAR INDUSTRY, BY PROF. KEDZIE.

To the Editor of the Free Press:

Certain industries in Michigan have produced large wealth, of which the farmers have received only a small part. Lumbering has made a large class of millionaires, while the farmer and teamster received only ordinary wages. The salt industry has made fortunes for many, but the only decided benefit to the farmer was the reduction in the price of his salt. The discovery of large deposits of coal will mainly benefit speculators who buy options on farms where coal is likely to be developed and the land owner will get the smallest share. Speculators bought up the pine lands and capitalists developed the salt industry; the salt trust took possession of the market and the coal trust bids fair to take the larger share of the profit into its hands and dictate prices for the public. Thus the owners of these sources of wealth are pushed aside and others reap the profits. It is natural that capital, energy and business capacity should receive a large part of the profits, and complaint is not made on this account.



Factory of LANSING SUGAR COMPANY, Lansing, Michigan. In process of erection, 1901.

SUGAR BEETS THE THING.

But there is one field in which the farmer is in evidence, and from the nature of the case must remain there, viz., sugar beets for manufacturing beet sugar. Here the farmer is the first party to consult and conciliate. If for any reason he refuses to raise the sugar beet, the beet sugar industry comes to a full stop. The farmer commands the situation. The result is that a fair division of the profits of this industry is made and the farmer receives a proportion that is satisfactory. Not only is this so, but this is the only industry where his equitable proportion of the profits comes directly into the pockets of the farmer in cash. The price does not depend upon quotations in Chicago, New York or Liverpool, but is determined by conditions at home. The sugar produced in our State is of such high quality that it does not require refining, but is ready for use just as it comes from the factory. In this respect the beet sugar made in Michigan differs from most commercial sugars. American machinery and skill have brought the process to such perfection that no refining is here required, the sugar as it comes from our factories is fit for immediate use—granulated sugar of high quality. Raw sugar requiring refining is not made in our State. The process is thus removed from any possibility of a monopoly. Any farmer can raise the beets and any capitalist can put up a factory for making the sugar. Competition is absolutely free on both sides. No trust is possible under such conditions; the only trust required is that the farmer and manufacturer should trust each other. To class the beet sugar industry with the sugar trust is absurd. Take these two facts (1) that the American method enables the manufacturer to turn out refined sugar, the only kind sent out from our sugar beet factories, and (2) beet sugar factories are possible only by the co-operation of the farmers in raising the beets, and it is seen that monopoly and trusts in the sugar industry are impossible in our State. Farming is free to all, and any man can build a factory who has the necessary cash.

SUGAR REFINING.

Much of the sugar that comes from abroad needs refining before it is fit to be placed on the market. The sugar refiners in eastern cities for a time had a monopoly of this business, selling the refined sugar at their own price, and thus fixing the price for refining to suit themselves. The fact that the price of "common stock in American Sugar Refining Co.," September 30, was more than 121 is evidence that it is a paying concern. Having a monopoly of refined sugar they fixed the price for any locality and season. The practice of "putting up the price of sugar a cent a pound during the canning season," and then allowing it to sink to its normal level when the "canning flurry" passed by was an illustration of the tactics of the sugar trust.

The monopoly of the sugar trust is threatened by the increasing production of granulated beet sugar by the American method, fit for immediate use as it leaves the factory, and has no need of refining. This production of sugar for consumption is a fatal blow to the monopoly of the sugar trust. If we can produce in the factory refined sugar in sufficient quantities to supply our people, the refiners' occupation is gone!

That a natural manufacturing process should thus supplant a grinding monopoly should be a matter of congratulation for our people.

The sugar trust recognizes the danger, and within the week has announced a cut in price of refined sugars to 3½ cents a pound in all the region where beet sugar competes with the trust sugar. This reduction of more than 31 per cent in the price of granulated sugar is surprising, but it is a blow at an innocent rival, and not a concession to the general consumer. If the rival is crushed the old prices will be again imposed.

AIMS OF THE SUGAR TRUST.

The sugar trust has not kept us in doubt about its aim and purpose. In its recognized organ, the Sugar Trade Journal, October 3, it says in explanation of the reduction of 1½ cents a pound on granulated sugar: "The notable feature of this movement is that the quotation of 3½ cents is on a level with the parity of raw beet sugars on the present basis, 3¾ cents for cane centrifugal sugar. In other words it would seem that the refined sugar interests of the country feel compelled to protect their interests to such an extent that the domestic beet sugar industry may not make any larger profits on the making of refined than would come to them from the manufacture and sale of raw sugar. We have always taken the position that the manufacture of raw sugar for sale to refiners was the proper and legitimate business of the beet sugar industry of the United States."

The beet sugar manufacturers may make raw sugar for the refiners, but must not make refined sugar to compete with the trust! A legitimate and profitable industry must cease at the demand of this monopoly. "By what authority doest thou these things, and who gave thee this authority?"

If our people concede to the sugar trust the exclusive right to refine sugar and adopt such measures by tariff changes or otheriwse as will give the trust the control of raw sugars, then a merciless power has seized the public by the throat.

WHY THE INDUSTRY SHOULD PROSPER.

1. It is the means by which the people can subvert a huge monopoly.
2. It is a legitimate industry, brought to a marvelous degree of perfection by American skill and ingenuity, and the people have a right to its full benefits.
3. The large amount of capital invested which deserves protection. Thirteen sugar factories have been erected in our State at a cost of $7,000,000. Next year the number of factories will be increased to twenty. There are now growing 60,000 acres of sugar beets in our State.
4. It is the money-getting crop for our farmers. Last year there were paid to Michigan farmers $1,500,000 for sugar beets. In Bay county in 1900, mortgages on 51 farms were paid off by money received for sugar beets. The price of farm lands near sugar factories has increased by $5 to $10 an acre.
5. It is a home industry, and the benefits abide with our people.

6. It is the natural antagonist of monopoly, and by its very nature is incapable of forming a trust of any kind.

7. It is the only great manufacturing industry in which the farmer must secure his share of the profits.

R. C. KEDZIE.

Agricultural College, Michigan.

THE FARMER AND BEET SUGAR.

[From Free Press Editorial, Oct. 11, 1901.]

Reduced to its simplest form Prof. Kedzie's argument in behalf of the beet sugar industry which was published in yesterday's issue of the Free Press, is this: The beet sugar industry is an excellent thing for the farmers that raise the beets.

This we can readily believe. Whether the industry is likely to prove profitable from the standpoint of the public is another matter.

Prof. Kedzie makes the point that it is impossible to form a trust in the beet sugar business; but we hardly think he has maintained his thesis. In fact, the entire beet sugar industry thus far has been to all intents and purposes in accordance with trust methods. There has been practically no competition between the producers of beet sugar and the company that controls the business of refining cane sugar. If the prices of beet sugar have been shaded slightly in certain districts for the benefit of the jobber, the consumer has not profited. He has paid as much for his sugar as he would have paid if there had not been a ton of sugar beets raised in the United States, and it is yet to be proved that the development of the industry is likely to lower the price to the consumer.

There is a wide diversion of expert opinion as to the cost of production. It is maintained by some that beet sugar can be manufactured and sold for three cents a pound, leaving a reasonable margin of profit. It is claimed by others that it cannot be manufactured profitably for less than five cents a pound. Whether then the public has anything to gain by encouragement of the industry depends on the cost of manufacture. It also depends in a way upon the relations of the United States to their new possessions. With Hawaii, Porto Rico and the Philippines annexed, and Cuba in the way of annexation, the great cane sugar districts of the world belong either actually or prospectively to the United States. If the tariff barriers were removed these islands would supply sufficient sugar to meet all the wants of the rapidly increasing population of the United States proper. Even if the refining business remained in the hands of a trust, the price of sugar would be less than beet sugar could actually be produced for, including the profit made by the refining company. To maintain a tariff then on raw sugar from these possessions amounts to a discrimination in favor of one section of the country as against another, for the benefit of comparatively few persons.

The fact that there can be no true trust in the manufacture of beet sugar is comparatively unimportant if the beet sugar cannot compete with trust refined cane sugar without legislative assistance.

This is the case of course, from the academic standpoint of the consumer. From the point of view of the farmer interested in the industry, it may be argued, that since he has helped to support a multitude of "infant industries" all these years from which he derived no benefit whatever, it is no more than fair that he should have a little protection now that he has discovered an infant industry in which the greater share of the profits belong to him. The claims of his pet industry are certainly as convincing as the claims of a lot of other infant industries, and we cannot blame him for demanding a share in the spoil. Certainly his interests are entitled to as much consideration as any else's interests. We do not include the public in this generalization; because where tariffs are tinkered the public is entitled to no consideration at all.

GIVE BEET SUGAR A FAIR CHANCE.

[From Free Press, Oct. 20, 1901.]

PROF. KEDZIE BELIEVES IT WILL BENEFIT THE COUNTRY.—COMPETITION WILL COMPEL REDUCTION OF THE PRICE.—MONEY SAVED THEREBY WILL AID EVERY OTHER INDUSTRY.

To the Editor of the Free Press:

From the editorial in the Free Press of October 11 on the beet sugar industry the following extract is made:

"Prof. Kedzie makes the point that it is impossible to form a trust in the beet sugar business; but we hardly think he has maintained his thesis. In fact, the entire beet sugar industry thus far has been to all intents and purposes in accordance with trust methods. There has been practically no competition between the producers of beet sugar and the company that controls the business of refining cane sugar. If the prices of beet sugar have been shaded slightly in certain districts for the benefit of the jobber, the consumer has not profited. He has paid as much for his sugar as he would have paid if there had not been a ton of sugar beets raised in the United States, and it is yet to be proved that the development of the industry is likely to lower the price to the consumer."

The statement that "the entire beet sugar industry thus far has been, to all intents and purposes, in accordance with trust methods," is passed by, because it had been shown that monopoly, or a trust, was impossible where competition was free and uncontrolled. A trust that includes the farmers as a class would be something new and rare.

"There has been practically no competition between the producers of beet sugar and the company that controls the business of refining cane sugar." Yet this very month the sugar trust has announced a reduction of more than 31 per cent in the price of refined sugar in places where beet sugar comes in competition with its sugar. A serious competition is thus announced between the producers of these two kinds of sugar. Secretary Wilson, in an interview last week said: "The operations of the sugar trust in cutting the price of sugar out west, where beets are grown, are likely to convince the American people that the beet industry is not controlled by the trust. The growth of the sugar beet industry has alarmed the trust."

REDUCTION IN PRICE OF SUGAR.

The editor proceeds to say: "It is yet to be proved that the development of the industry is likely to lower the price to the consumer." Time is a necessary condition for the development of any industry. A husband at dinner remarked to his wife that he was "disappointed not to have fried chicken for dinner. You remember I brought home a basket of eggs yesterday." "But it takes time for eggs to hatch into chickens, and a longer time for the chickens to grow to the frying size. Have patience."

The tendency of all manufacturing industries, when sufficient time is allowed, is to reduce the price of the product. Thirty years ago Prof. Tracy bought some wire nails to use at the college, paying 20 cents a pound; they are now sold for four cents. Fifty years ago cotton sheeting sold for 12½ a yard, that now sells for five cents. A box of friction matches cost 25 cents; now two cents. In 1854 I bought in Kalamazoo a gallon of kerosene, for which I paid $1.50. With better machinery, improved methods, and competition, the price has fallen until a better kerosene is now sold for eight cents. This is the history of every species of manufacturing when left open to free competition, and to some extent even under monopoly.

Will the sugar industry be an exception to this general law? I have seen the price of refined sugar fall from 18¾ cents to five cents, till the trust took hold of it, and the price is now six cents in Lansing. What will be the influence of beet sugar on prices in the near future? The industry is yet in its early infancy. Ten years ago there were two factories in Nebraska, and three in California, or five factories in our land. Three years ago one factory was erected in Bay City. The next year factories were built in Alma, Caro, Rochester, Holland and Benton Harbor, and this year thirteen factories will be in operation. Is it reasonable to expect that this infant industry in three years shall so compete with the giant sugar trust as to compel the general reduction in price of commercial sugars? Give the eggs time to hatch, and the chickens to grow. If left to the natural laws of manufacturing industries I feel confident that within five years refined sugar will be sold in our groceries for five cents a pound. The inevitable competition of factory with factory and of all the factories with the sugar trust will compel a marked reduction in price.

INCIDENTAL BENEFITS.

The incidental, though less obvious, benefits of the sugar beet industry are not to be overlooked. While the price of products is on the descending scale, the price of labor in our country and age is on the ascending scale. The one costly, and ever increasing thing in price in our land, is human toil. Fifty years ago the usual wages for the common laborer was 50 cents a day, except in time of harvest. I once heard the Sir Oracle of our village lay down the law to a group of laborers in these words: "Fifty cents a day is fair pay for a man who works from sun to sun. If a young man earns 50 cents a day and salts it down, he will be a rich man before he dies." The crowd gave general assent to these words of wisdom. But the price of labor soon began to rise, and for forty years has gone upward until it has become impossible to hire a man to work from sun to sun for 50 cents. In 1849 gold was discovered in California, and men poured into the mines from all parts of the country in such numbers that a golden stream began to flow back from the golden shores of the Pacific, and the addition of this precious metal gave a marked increase to the volume and stability of our circulating medium. Sound money may be called the arterial blood of our industrial system. The increase of our circulating medium gave such an impetus to every industry, cheapening products yet enhancing the price of labor, that we would shudder to be thrust back into the industrial and social conditions of fifty years ago.

If the introduction of the $80,000,000 mined in California since 1849 has done so much for our people, what will be the result, on the same lines, of retaining $100,000,000 yearly in our county in further building up our industries and increasing the wages of every class of our workers?

The reduction of one cent a pound in the price of sugar is a blessed boon to our people. But the retention of $100,000,000 a year in our country, through its incidental benefit, is more significant still. It is not merely the saving of so much money, but it is the increase of manufacturing capital, and this, poured in good part, into the pockets of those who most need this working capital. This we hope to see accomplished through the sugar beet industry. It is not a mere question of a cent a pound; it a question of building up and expanding every legitimate industry in our country. For this we ask the sympathy and support of the intelligent public.

R. C. KEDZIE.

Agricultural College, Michigan.

CUBA, BEET SUGAR AND THE FARMER.

There is one phase of the beet sugar question, which Prof. Kedzie overlooked in the very able argument he presented to the readers of the Free Press, Sunday, a phase which relates to the vitally important matter of the annexation of Cuba. In discussing the benefits to be derived from the manufacture of beet sugar in this country, he says:

"The reduction of one cent a pound in the price of sugar is a blessed boon to our people. But the retention of $100,000,000 a year in our country, through its incidental benefit, is more significant still. It is not merely the saving of so much money, but it is the increase of manufacturing capital, and this, poured in good part, into the pockets of those who most need this working capital. This we hope to see accomplished through the sugar beet industry."

Factory of WEST BAY CITY SUGAR COMPANY, West Bay City, Michigan.

This is undoubtedly true but there is Cuba to be considered. That annexation is the natural destiny of the island is so obvious that we need not discuss it: that the annexation of Cuba would be of tremendous importance to the United States is also too plain to warrant a detailed relation of the advantages. The opposition within the United States to the annexation of Cuba comes chiefly from the tobacco and the beet sugar interests. They cannot be blamed for considering their own welfare, but the fact remains, nevertheless.

We think that on the whole Cuba is worth more to the United States than the building up of a beet sugar industry. Cuba can raise a sufficient quantity of cane to manufacture nearly all the sugar the country will consume for many years. The Cuban cane sugar can be sold at a profit cheaper that the beet sugar can be manufactured in the United States. It is a serious question whether it would not be more profitable to the country in the end to allow Cuba to manufacture the sugar while the American farmer devoted his energies to other forms of agriculture.

Prof. Kedzie does not agree with us that the cost of sugar to the consumer is not likely to be cheapened by the development of the beet sugar industry, and calls attention to the reduction in the price of nails, cotton sheeting, matches, oil, etc., during the last twenty-five years. But this cheapening has all been due to the profection of labor-saving machinery, and it is doubtful whether there can be great advance in the way of further cheapening the cost of manufacturing beet sugar. The great item of expense is labor, hand labor that cannot be cheapened or made more effective except to the detriment of the community. The beets cannot be weeded or thinned by machinery.

Then, too, the interest on the money invested in the plant is bound to continue, even though the machinery can be operated only three or four months in the year. The normal element of deterioration will not be changed greatly. If any great cheapening is effected in the manufacture of beet sugar, it seems to us that the farmer and his employes will be the chief sufferers. The company will pay the farmer less for beets. The farmer in turn will be compelled to employ cheaper labor, and the benefits may be far less apparent ten years hence than they are today. At present the farmer is the principal beneficiary of the beet sugar industry; but even if Cuba is not annexed it is economically improbable that he will long remain the chief beneficiary.

At the same time we have no disposition to discourage the industry. We desire only to call attention to the fact that there are other interests and other elements to be considered.—Free Press, Oct. 22, 1901.

THE ANNEXATION OF CUBA.

I was not unmindful of the perplexing problems thrust upon us by the annexation of our island possessions, present and possible. We catch our breath in apprehension when we consider the political and social tangle in the Sandwich Islands, small as they are, we look with doubt and misgiving upon Porto Rico, a cold sweat breaks out when we turn our eyes to the Philippines and think of the 9,000,000 savages on our hands that we must civilize and finally take into full citizenship, asking them to help govern our country—a veritable "old man of the sea" that we cannot shake off and dare not let go! If with the wide rolling waves of the Pacific we could wash our hands clean of the whole motley crew! Then think of the 9,000,000 blacks and mixed races at the south whose political and social management is straining the bonds of constitutional construction almost to the breaking point, and ask ourselves whether we want, in addition to all these perplexing problems to take on our hands the yet more incongruous millions of Cuba—a people alien in race, foreign in language and without the national instincts that dominate our people.

We have accomplished great results and have changed the map of the world in three years. Let us pause in our swift course, catch up with ourselves, and take our bearings in the swift moving tide of nations. Let Cuba, full of plots and intrigues and without the cohesion of a uniform race, have time to heal her dissensions, educate her people, and unite her discordant and belligerent tribes into a homogeneous political system before she is welcomed into the sisterhood of American states. Let her remain for a decade a probationer before she seeks admittance.

More than this, at the very outset of our conflict with Spain we gave the world our solemn pledge that we would not annex Cuba. If we break our word and annex "the gem of the Antilles," how will the nations of Europe treat such manifestation of bad faith? How about Germany, envious of our marvelous growth and looking with sullen disdain upon our Monroe doctrine?

THE COMMERCIAL PROBLEM.

In addition to these considerations, a great commercial problem confronts us. Leaving out of account the states bordering on the Mediterranean (excluded from this industry by climatic conditions), the whole of central Europe from the Atlantic to the Black Sea, is deeply interested in the beet sugar industry. With all these nations a foreign market for beet sugar is a question of first importance, and they will not tamely accept their exclusion from the best market in the world. If by annexing Cuba and pouring into that tropical island American machinery, skill and capital, we forestall the sugar market of America, we shall thereby give the nations of central Europe a common rallying point to concentrate their scattered forces against our people to cripple our commerce.

REDUCTION OF TARIFF ON RAW SUGAR.

Here lies the greatest danger to this industry. The sugar trusts appreciate the fact that the surest way to destroy the beet sugar industry at this state of development is to remove the tariff on raw sugar, or at least, to lower the excise to such a rate as will prevent successful competition. The efforts of the trusts will be directed to securing action by Congress which will prove unfriendly if not destructive to this new industry. The leader of the trusts outlined a plan of this kind, and very recently said "Congress will give us the tariff we want." Suppose congress reduces the tariff on Cuban sugar, what have we gained? Destroyed a great industry to build up a business rival in a people foreign to us, and a stranger to our civilization—to stab our child to succor a foundling!

But this would not close the incident. Under the "favored nation" clause of our treaties France, Germany, Austria and Russia would demand the same concessions and we must reduce our tariff to the same degree as in the case of Cuba, and the final outcome would be the slaughter of the sugar industry in our country and its transfer to foreign lands.

The question brought down to its simplest terms is this. Shall Germans, Cubans and others have control of sugar production for Americans, pocketing the profits? or shall Uncle Sam do this business "on his own hook?" Watch the next Congress for an answer.

THE COMPARATIVE VALUE OF CANE AND BEET SUGAR.

[From The Michigan Farmer, Nov. 2, 1901.]

The inquiry is often made, by person and by letter, about the relative value of cane and beet sugar, and whether beet sugar can be used for the same purposes as cane sugar. The following letter from a leading citizen of Sanilac county is a fair sample of such inquiries which I desire to answer through your widely circulated paper and thus answer the question once for all:

Prof. R. C. Kedzie, Agricultural College, Michigan:

Recently I have met several persons who claim that beet sugar is not as good as cane sugar, that it will not keep fruit when used in canning, etc.

Can I presume upon your kindness to give me a positive statement touching this matter?

This "Thumb" of Michigan is going wild on this sugar beet question. I apprehend that we owe much to you and M. A. C. for the development of the resources of our State in this direction. M. A. C. is not on trial any longer. She has proved her worth—her success is assured.

HENRY OLDFIELD.

There is only one answer to these questions. CANE SUGAR AND BEET SUGAR ARE THE SAME. It is not a question of similarity, but of identity. Chemists, the world over, are agreed as to the identity of cane and beet sugar, and all statements of difference in properties—of inferiority or superiority in these sugars—are made either in ignorance or for deception. We sometimes say "as like as two peas;" but no two peas are exactly alike; such comparison does not hold on this subject, for it is not a question of likeness but of identity.

The suspicion was aroused by the sugar trust that beet sugar was inferior to cane sugar, and this suspicion has been carefully nourished by the sugar trust, and the statement has been so often repeated that many folks have believed it. What are the facts? For the last three years the people of the northern states have used beet sugar almost exclusively. Look at the world's sugar production in 1898. We were at war with Spain and little sugar was produced in Cuba and Porto Rico, and less still was exported. None was obtained from the Philippine Islands; the sugar from the Sandwich Islands was required for our people on the Pacific Coast; Louisiana could not make enough sugar to supply herself and the Gulf States. Where could we get enough sugar to supply the millions of tons required for the world's consumption if we depended on sugar from the cane alone? The supply of sugar from sugar cane has been insufficient to fill and replenish the world's sugar bowl, and for three years past we have been in large measure cut off from that source. If it had not been for the beet sugar of Europe the world would have gone hungry. Beet sugar at this very time furnishes two-thirds of the world's supply. The supply of refined sugar for our own use for three years past has consisted very largely of beet sugar from Germany and France.

SHIPLOADS OF BEET SUGAR.

When Prof. F. S. Kedzie returned from Germany in December, 1898, he took passage at Hamburg on the large freight steamer Pennsylvania, and her entire cargo (19,000 tons) consisted of raw beet sugar from Germany for the sugar refineries in New York. This was only one shipload of raw sugar, and cargo after cargo was brought from the same source and for like purpose, viz., to be refined by the sugar trust and then sold for "pure cane sugar." Did the sugar trust ever inform us that they were selling beet sugar, and that their vaunted cane sugar was in large part only refined beet sugar? I trow not. And these are the parties who are warning us about the inferior qualities of beet sugar and the superiority of cane sugar!

Why such deception? Because the American manufacturers have brought the process to such perfection that they turn out from their factories refined sugar, and nothing but refined sugar, requiring no aid from the sugar refiners of New York. If this superior process comes into general use "Othello's occupation is gone" in this country, and our own factories will furnish our people with pure sugar "fresh from the mint;" and the sugar trust, with its peculiar methods, may retire from the scene. "Hence these tears!"

R. C. KEDZIE.

Agricultural College, Oct. 26, 1901.

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